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The river and harbor bill, now before the Senate Commerce Committee, carries an appropriation of $20,000 for a survey of every route by which a ship canal could be constructed between Lake Erie and the Ohio River. As provided for in the bill, this canal would be only 70 ft. wide, 7 ft. deep, with locks capable of handling vessels 150 ft. long and 21 ft. wide. The same bill in another paragraph devotes $10,000 to the survey and location of a canal connecting Lake Superior and the Mississippi River. Both surveys are to be made by government engineers. For continuing work on the Hennepin canal $190,000 is appropriated. No appropriations are so far made for the Lake Erie and Hudson River Canal surveys.

The Willis Ave. bridge across the Harlem River, of which Mr. Thomas C. Clark is the consulting engineer, will have the following dimensions: Length, about 2,600 ft.; width, 60 ft.; superficial area, 156,000 sq. ft.; estimated cost, $10 per square foot, or $1,560,000. This is the average cost of the new Kings bridge and the bridges at Seventh and Third avenues over the Harlem River; though it is expected that this bridge will be let at a lower cost, as the market is still falling. The clear height above high water is to be 24 ft. The difficult part of the problem will lie in the clearing without interference the terminal yard of the N. Y., N. H. & H. R. R., one of the most important in the city, with many tracks and ferry slips. Plans will be prepared for public hearing and inspection in the coming fall of this year. Willis Ave. is practically a continuation of Avenue A on Manhattan Island, near the mouth of the Harlem River.

An elevated water-works tank at Salem, S. Dak., fell on July 13. Mr. M. A. Blackburn, City Engineer and Superintendent of Water-Works, informs us that the wreck was caused by the failure of the 2-in. joists which supported the tank. The dimensions of the tank are not available, but its capacity is given as 60,000 gallons, which would make the weight of water alone some 240 tons. It is reported that the tank wrecked the pump house and machinery.

The most serious railway accident of the week was the derailment of a north-bound passenger train July 23 near Queen City, Tex., on the Texas & Pacific Ry. Seven persons were killed.——Another serious accident was the derailment by strikers of an east-bound express on the Chicago & Grand Trunk Ry. near Battle Creek, Mich., July 16. Splice bars had been taken off and the rails spread, ditching the engine, baggage and express car and two day cars, but the Pullman cars remained on the track. One man was killed and 14 persons were injured.——On July 23 there was a head collision at Griffiths, O., on the Cleveland, Cincinnati, Chicago & St. Louis Ry., between an express train and a light engine. Three men were killed and ten injured. The engineman of the light engine made a mistake in his orders.

A crossing accident occurred July 19 at Chappell, Ill. The signalman had given a train on the Calumet Terminal Ry. the right of way, but the engineman of a train on the Chicago & Alton Ry. did not heed the danger signal and ran into the open derailing switch, the engine and three mail and baggage cars being ditched. Nine persons were injured, seven of whom were mail clerks.

A highway bridge over the Ottawa River at Allentown, O., gave way under a portable engine being hauled by horses, July 15, and the driver and horses were killed.

A 20-ft. flywheel in the Manville cotton mills at Manville, R. I., burst July 18, and the flying fragments broke two other flywheels of the same size. Nobody was injured, but great damage was done to the machinery and plant. There are four water wheels and three Corliss steam engines of 500 HP. each, but owing to low water only the latter were in use. The wheels were making 92 revolutions per minute.

The bottom of a converter at the Homestead mills of the Carnegie Steel Co. blew out on July 19, and two men were killed and two fatally injured by the molten metal. These men were cleaners at work in the casting pit.

The people of Boston voted for rapid transit, which may mean the Meigs system, on July 24, but both the majority and the total vote were small, the vote being 15,492 for and 14,214 against the scheme, a majority of 1,278. The vote was taken in accordance with an act incorporating the Boston Elevated Ry. Co., which provided that the road should not be constructed unless the voters declared in its favor at the special election of yesterday. A brief outline of the project was given in Engineering News of July 12.

Bids for an additional water supply of 25,000,000 gallons per day for the city of Brooklyn are wanted until Aug. 15, the aldermen having at last concurred with the council in appropriating $750,000 for the purpose. The supply will be pumped from wells, the pumping stations to be located on the line and south of the present conduit, between Rockville Center and Massapequa. This portion of the conduit comprises the recent extension to the works, described in Engineering News, beginning March 7, 1891, in which issue a map of the old and new conduit was shown. The conduit extension and its accompanying reservoirs were designed to intercept all the surface water north of the conduit to the ridge of Long Island. The proposed wells will be on the ocean side of the conduit and are designed to lap the underflow, as it would be termed in the West. A number of driven well plants are already connected with the Brooklyn water-works, as outlined in our issue of March 7. Further particulars regarding the proposals for extensions are given in the advertising columns of this issue. Mr. Alfred T. White is commissioner of city works.

The Royal Commission on Coal Dust in Mines, in its last report, practically prohibits shot-firing with gunpowder in any dry and dusty mine. Flameless explosives can be used without apprehension. The commission founds its unanimous conclusion upon the general weight of evidence and especially upon a careful series of experiments conducted for them by Inspector Hall, of the Lancashire district. Mr. Hall experimented in an unused mine with coal dust brought from all parts of the country and the result was that he found that dust in any mine, whether termed fiery or not, was an element of great danger when brought into contact with gunpowder flame. In the same mine and with the same dust flameless explosive produced no harm.

Gas-motors for pumping purposes are quite extensively used in Germany, says the "Journal fuer Gasbeleuchtung," which gives a list of 42 such establishments. Four of these motors, at Dusseldorf, operate centrifugal sewage pumps which lift 16,000 gallons per minute 16½ ft. high. At Rettweil a motor of 20 effective HP. drives a horizontal double piston pump, which delivers 132 gallons per minute against a head of 315 ft. The two pump cylinders have a diameter of 6.7 ins. and 6.4 ins., with a stroke of 20 ins. and 14 revolutions per minute. All the motors are of the Otto type.

The tests of smokeless powder now being conducted at Indian Head by the naval ordnance officers continue. On July 21 an American powder, Leonard's nitro-glycerine smokeless powder, was used in an 8-in. rifle behind a 250-lb. projectile. It developed the enormous velocity of 2,650 ft.-sec., with a chamber pressure of only 14.8 tons per square inch. The best brown hexagonal powder, under similar conditions, gives a velocity of 2,100 ft.-sec., with 15 tons pressure. The keeping qualities of this nitro-glycerine powder have yet to be determined, especially in tropical climates.

Philadelphia, in these hot days, is having its annual press agitation for an extended water supply. Director Windrim favors the construction of the Perkiomen gravity supply first proposed by Chief Engineer Birkenbine in 1865. He says that for about $19,000,000 reservoirs and a conduit can be built that will supply 250,000,000 gallons daily for 100 consecutive days. The cost has stood in the way of approval by Councils, but Mr. Windrim says that a gravity supply would pay for itself in ten years by the increased income from water consumed. All of the present supply is pumped, and the available combined capacity of the storage reservoirs is in round numbers 1,000,000,000, which is said to be about equal to a six days' supply.

An 18-in. Harveyized nickel-steel armor plate, made by the Bethlehem Co., was again tested on July 20. The company's officials claim that the first plate tested suffered from a flaw as it came from the mill. In the last test two 12-in. shots failed to penetrate more than 12 ins. The first shot was backed with a powder charge of 249¾ lbs. of powder and developed a velocity of 1,465 ft.-sec. It struck the plate to left of the center, 3 ft. from the top, and penetrated about 8 ins., with no visible cracks. The second shot had 397½ lbs. of powder behind it and a velocity of 1,926 ft.-sec. It struck the plate a little above the center and penetrated 12 ins., but it also cracked the plate in an irregular line from top to bottom. Half the shell remained embedded in the plate. The naval officers present considered the trial satisfactory and that the plate would be an absolute protection to the ship. The officials of the Bethlehem company believe that large plates can be Harveyized with profit, but that thinner plates will show a proportionately better record.

Fuller details of the latest ordnance test at Indian Head, on July 13, briefly noted in our last issue, are as follows: A 17-in. barbette armor plate, made by the Carnegie Co., and backed by 36 ins. of oak was tested. A 12-in. rifle at 500 yds. range was used, and two rounds were fired. The first was with a Carpenter projectile, with a velocity of 1,410 ft.-sec., fired for the purpose of deciding the resistance of the plate to cracking. This first projectile penetrated about 13 ins. into the plate; the point was welded, and the remainder of the shot rebounded entire and only a little set up. The plate was not especially damaged, and there were no cracks. The second shot, intended to test the resistance to penetration, was a 12-in. Wheeler-Sterling projectile, with 600 lbs. of powder and a velocity of 1,858 ft.-sec. This shot struck the middle of the plate and went clear through the plate, the 36-in. oak backing, and was found 100 yds. to the rear of the target only slightly deformed. The hole in the plate was clean cut and little larger than the shot. On July 13 a Carpenter shell, with 1,850 ft.-sec. velocity, was fired at the same plate and barely stuck its point through the armor plate. The plate was rejected as too soft. An 18-in. Harveyized nickel steel plate, made at Bethlehem, is on the ground to be tested next. No armor of this latter thickness has yet been accepted by the government.

The Harlem River improvements, now being carried out by the government, will almost double the water-front of New York harbor available for commercial use. While Manhattan Island is about 30 miles in circumference, only 19 miles of this frontage were commercially useful. Taking only what can be properly utilized, the completed Harlem River work would add about 14½ miles of additional wharf-room within the city limits. The engineer's plans contemplate a canal 400 ft. wide and 15 ft. deep at mean low-water. This channel is now taken out practically to the full width, but it is only 10 ft. deep, a further expenditure of $2,000,000 being required to secure the other 5 ft. But as there is 5 ft. of tide the present channel is 15 ft. deep at high-water. The Harlem River, up as far as High Bridge, now has from 15 to 20 ft. of water in the channel at low tide. The last government report shows for 1893 an actual commerce on the Harlem River and Spuyten Duyvil Creek amounting to 5,910,376 tons, and $190,140,712 in value. This commerce has increased 75% within three years. This traffic of 1893 was carried on by 20,361 canal boats, barges and railway floats, 4,476 sailing vessels and 15,241 steamers and tugs, excluding naphtha launches. Of the seven bridges spanning the Harlem River, all but two are higher above the surface of water than the "24 ft. above high spring tide" required by the law of 1879. The two bridges lower than this both belong to the New York Central R. R. Co.

CLOSING THE TIMBER AND STONE DAM AT BANGOR, ME.

By G. W. Pearsons, M. Am. Soc. C. E.

In 1875 the city of Bangor commenced building a dam at Treat's Falls, on the Penobscot River, for the purpose of driving the machinery of the water-works and furnishing other power. The dam was a large one, being some 900 ft. between the masonry ends, and requiring for its construction some 6,000,000 ft. of timber and 80,000 cu. yds. of stone.

The ends of the dam were of granite masonry, laid in cement. The west end was short, being on solid rock. The east end extended some 200 or 300 ft. into a sloping bank of very hard heavy clay, underlaid with cemented gravel, seemingly as secure as solid rock. The trench for the masonry was carried well into this, and it seemed a waste

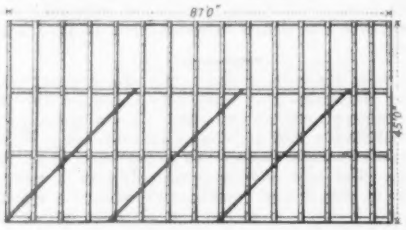


Fig. 1. Sounding Float.

of good granite to dig such a pit to bury it in. Looking at it, however, after the break at Austin, the judgment of the eminent engineer under whose advice it was done, Mr. J. B. Francis, seems less extravagant.

Treat's Falls is about a mile above the city, at the point where the river at low tide meets the ocean level, high tide reaching a mile further up stream. The river bed, so far as it could be examined at the location of the dam, appeared to be successive ridges of rock, between which cemented gravel made a nearly level bottom that seemed favorable for the construction adopted, timber crib work filled with stone. Considerable of the bottom near and at the shores was bare at low tide, and the work was commenced by laying timbers on the bottom at low tide and building up as the tide allowed. The timber was hemlock, for the most part, simply flatted by taking a slab off each side. A portion for outside work had another slab taken off, making three straight sides. It was piled without cutting down and the open spaces entirely filled with stone.

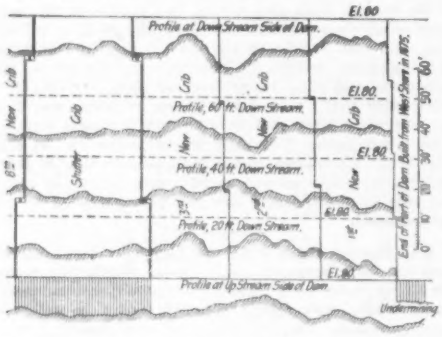


Fig. 2. Plan and Profiles of Cribs and Shutter Crib.

In the beginning of the work, alternate spaces were left open, making sluices about 5 ft. square. It was expected that these would pass the water when the river was low and thus enable the dam to be completed, but the great number of mills on the river, notwithstanding the care exercised in burning the slabs and other waste, made so much floating material as to close the sluices in spite of the efforts to prevent it. First a slab would swing across a sluiceway, which, followed by more slabs and other floating debris, made a rack that, with the shreds from the shingle mills, soon closed the openings so tightly that not even a leak showed where they were. The sluices were therefore discontinued, and when past the ground bare at low tide cribs were constructed and sunk in place, the irregularity being connected by timber put on above low water, no more being sunk than was necessary to make them accessible at such times. In this manner about half of the length of the dam was built during the first season.

In the spring it was found that the concentrated scour of the fall and spring floods had carried out the filling between the slate ledges in the river bed and given a very different cross-section than previously existed. Efforts were made to take soundings by which cribs could be built, but it proved very difficult to determine locations exactly, and the mode adopted of taking soundings by using a level on the shore was too slow to be practicable, only from 1 to 1½ hours, just after the turn of the tide, being available for the work. (The rise of tide was from 16 to 21 ft.)

Some cribs were made and sunk for the continuation of the raft chute, but no advance had

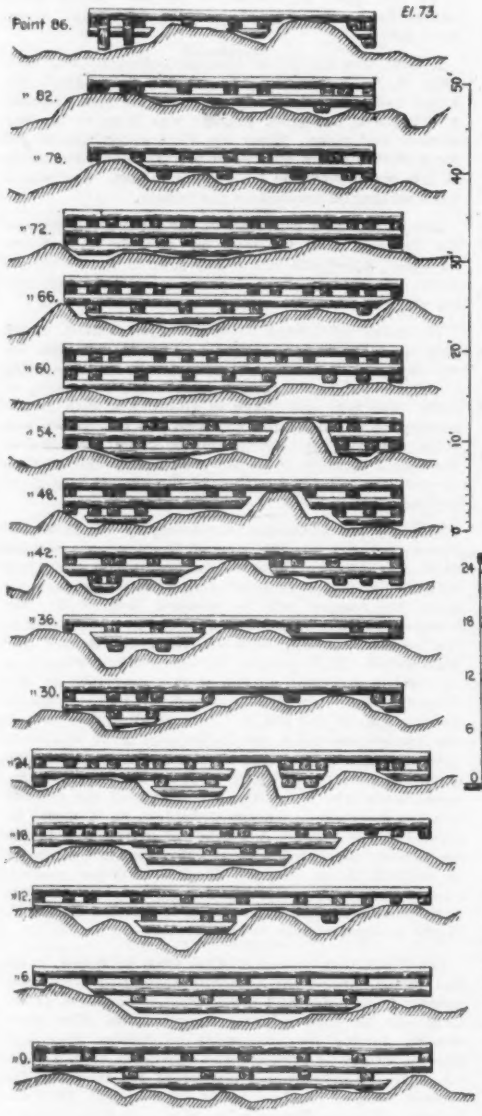


Fig. 4. Profiles of Shutter Crib.

been made on the closing of the dam when the writer was put in charge by the brief ceremony of an introduction to the foreman, there being some 250 men on the work at the time.

The first thing necessary was to get reliable soundings. A float was made, 45 × 87 ft., by crossing timbers with plank, as shown by Fig. 1. One edge of the crib was made straight, and the cross plank placed as required by the timbering of the cribs. Each plank was plainly marked at intervals of 2 ft., thus locating soundings 2 ft. apart one way and from 4 to 6 ft. the other, beside which soundings were taken whenever the irregularity of the bottom made it advisable. The sounding crib was floated to place and fastened by ropes from each end passing to the dam at the other end, by which means it could be kept closely in position during a rise of 4 or 5 ft. Two 20-ft. sounding poles were made and marked in tenths of feet, full numbers being used and no attention paid to foot marks. A board similarly marked was nailed onto the dam and a boy stationed to call each tenth as the water rose to it, all soundings being taken in rising tide, as at that time the tide nearly balanced the river current. An attendant with note-book recorded the soundings. In this manner we were able to take all the soundings for a crib, sometimes nearly 400, during a single tide. Some 13 cribs were sunk after such soundings and none varied 6 ins. from coming to a level seat. Some of the soundings at low tide varied from 3 to 17 ft. and all the work was done on a rising tide. The shutter crib was located where the bottom was most nearly regular. It is shown in plan in relation to the other cribs by Fig. 2 and in enlarged plan and

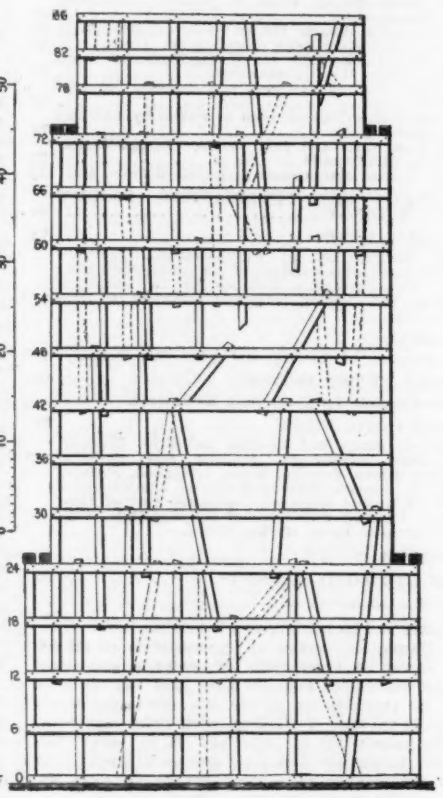


Fig. 3. Plan of Shutter Crib.

several sections by Figs. 3 and 4. Some of the cribs required 14 courses before they became whole, so as to allow regular work. This crib when floated to place drew about 20 ft. of water, it being necessary to build it up so that the water could pass through the 80 ft. of low work left for the cofferdam.

The cribs were of varying sizes, determined by finding where the best support for the sides could be had. Below low water the timber was all 1 ft. thick for convenience of construction and it was planked over, except at some interior openings. The cribs were guided to their place by means of plank spiked into them and extending above the water, and they were sunk at high tide. The shutter crib had larger offsets in which heavy timbers were placed to take the pressure of the water before sufficient load could be secured. It was floated to place successfully, as many scows, loaded with stone, as could be got around it being used and the first loading done very quickly. The work was done while the river was low, the opening being sufficient to pass the water at that time. The water thus remained at nearly a level above the dam, passing over the site left for the cofferdam at no time less than 8 ft. deep.

The portion of the cofferdam on the main dam was built in place and requires no description. A corresponding section was built on the shutter crib and connected with it. The east end of the dam was left 6 ft. lower and a cofferdam provided to close this opening after the lower one was closed,

but the rise of the river, coming on somewhat earlier than was expected, carried the water to the top of the main dam, compelling the cofferdam to sustain between 3 and 4 ft. more head than it was built for. The sketch, Fig. 5, will help illustrate this. The timbers were all fitted and marked in advance of their being placed, seven of them being left out to permit the passage of rafts. Cleats were spiked to them, and when placed planks were driven down, one by one, till the spaces were filled. The leaks incident to this construction soon closed up as in the case of the

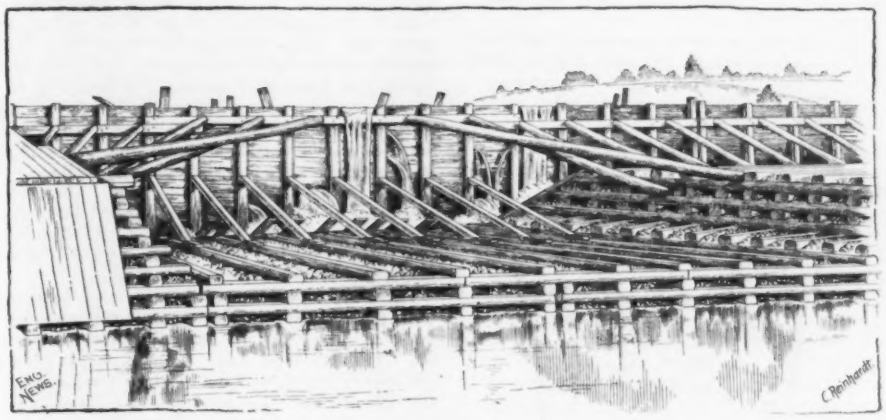


FIG. 5. SKETCH OF EAST COFFER DAM.

sluices, described above. A heavy bearing timber was placed near the top, braced from the sides, some of these braces being 70 ft. long and 2 ft. in diameter. Braces to the substructure were placed below these, pockets being prepared for them, so that they could be placed under water. The whole looked strong enough, and by figures had a good factor of safety, but when the river looked over to see what we were doing, we didn't think our fence any too strong.

Placing the bulkhead timbers was the most critical part of the work, as they had to be put down on the crest of the fall, the sheet of water being 8 ft. deep. A scow was prepared with three capstans and a pair of swinging davits, shown in Fig. 6. A heavy plank was bolted across the top of a bulkhead timber, by which it was swung to these davits in a nearly vertical position. A line was made fast by a large loop near the bottom of the timber, and passed under the scow lengthwise, through a sheave in a timber, which we may call a bowsprit, and back to a capstan. Two heavy hawsers, anchored upstream, were attached to the two other capstans, and the scow slowly and carefully let down nearly to place. The first effort failed from the hawsers stretching under the great strain, in releasing the lower end of the bulkhead timber. The scow was forced upstream again, the timber replaced in position, and the scow let down within 3 or 4 ft. of the required place. The hawsers soon stretched again, but gave us time to get the timber entered at the bottom, and, releasing the davits, it dropped to place. Like care being taken with the others, all were soon placed, and the only failure on the whole work was the one recorded, occasioning a half hour's delay.

A 182-FT. SPAN PLATE GIRDER SWING BRIDGE.

(With inset.)

We illustrate on our inset sheet this week a general elevation and details of the turning and lifting machinery for a 182-ft. plate girder swing bridge, which is being built to carry the line of the new Washington & Chesapeake Beach Ry. across the Patuxent River. This railway is being constructed from Washington, D. C., to the resort known as Chesapeake Beach, on the shore of Chesapeake Bay, about 30 miles from Washington. With the exception of the structure illustrated, there are no bridges of any importance on the line. This is a single-track, center-bearing, plate-girder swing bridge, 182 ft. long over all, designed by Mr. C. E. Fowler, Assoc. M. Am. Soc. C. E., Chief Engineer of the Youngstown Bridge Co., which has the contract for building the bridge.

The girders were designed to carry the dead load and a live load of 3,000 lbs. per lin. ft. A general elevation of the bridge is shown on the inset sheet, together with plans and sections showing the lifting and turning machinery. The piers are steel tubes filled with concrete. The pivot pier carries the center casting on stone work, built into the concrete, while the balance wheels run on a cast iron truck grouted on the concrete and anchored to the pier. The center is designed to facilitate shop work as much as possible and at the same time preserve the strength of the work. This is accomplished by making both top and bottom castings, which bear against the conical rollers, of cast steel, without projections either at the center or outside. The rollers are kept in position by a cast spider at the center, working on the center pin, and by the live ring at the outside. The balance wheels are designed heavy enough to carry about one-third of the load, so that in case of tipping they will be amply strong. The center casting and conical rollers, being cast steel, are made of sufficient size to carry the maximum load that will come upon the bridge, considered as entirely center bearing. Further details of the construction are shown by the drawings.

The structure is of soft steel throughout, with the exception of the flange angles, which are of medium steel, reamed. As the girders were designed according to Thacher's specifications for railway bridges, one-sixth of the web is included in the flange area, and this is made effective by horizontal splices on the web at the joints. The bridge is now completed, ready for erection, at the shops of the Youngstown Bridge Co., Youngstown, Ohio.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Common Repute as Evidence of Boundaries.

The Supreme Court of Minnesota states, in the recently decided case of Thoen vs. Roche (58 Northwestern Reporter, 686) that there is considerable difference between the English and many American authorities in the application of the rule which admits evidence of common repute on the question of boundaries. The English decisions confine it to cases of boundaries that are matters of public or common interest, such as boundaries of counties, towns, parishes or manors. Many American decisions go beyond this, some going so far as to apply the rule to cases of purely private boundaries, where no one has any interest in the question but the two owners of adjoining estates. Some of those are without the support of reason for the rule. The rule rests on necessity, better evidence of the boundary having ceased to exist, and is justified on the theory that where many persons, members of a community more or less extensive, are interested in a common boundary, they will know where it is, and their common assent will prove what they know. Boundaries and monuments for boundaries, the court holds, under the United States system of surveys, come within the reason for the rule, and within its application, even under the English decisions.

Declarations of a Deceased Surveyor as Evidence.

In the case of Cottingham v. Seward, recently decided by the Court of Civil Appeals of Texas (25 Southwestern Reporter, 797), the location of the east line of a certain tract was the sole issue. To show the position of this line, the records of a deceased surveyor, as to the field notes of other surveys calling for the same line, were introduced in evidence. These were contiguous surveys to the one in question, and were, in effect, written declarations as to the location of the line in question, and all were made by the same surveyor. The court holds, under these circumstances, that, the surveyor who made the survey in question being dead, these declarations of his as to the locality of a line called for in his field notes would be admissible. It also holds that when these declarations are written, and made at the time of the surveys, one at least which was made about the time the survey to be located was made, they are of equal, if not greater force than verbal declarations. It does not matter whether these surveys were valid or not, or whether they should have been recorded. Furthermore, the rule is laid down that when a marked line is called for in a grant, and that line can be located, it will control a call for course and distance. The fundamental principle in all cases is to ascertain where the survey was actually made upon the ground. In carrying out this principle it does not matter that a survey is increased or diminished by it. In the case of Angle v. Young (25 Southwestern Reporter, 798) the same court says that the declarations of a deceased surveyor, who made the original survey, are held to be a species of hearsay testimony that will be permitted. This is one of the exceptions ingrafted upon the general rule that heresay testimony is not admissible. But the declarations of a deceased surveyor who was not present when the original survey was made, and who merely afterwards subdivided a portion of it, will not be admitted to determine the location of the lines and corners of the original survey.

Surveys of Public Lands.

Evidence tending to show long recognition of certain lines by owners of lands on the surveys thereof is ignored by the Court of Civil Appeals of Texas in the case of Ratliff v. Burleson (25 S. W. Rep., 985) because it says such recognition, or even agreements between owners of adjacent lands such as would estop them from asserting rights adverse to such agreement, cannot in any way affect public domain, or appropriate any portion of it. In the absence of any artificial or natural objections called for in surveys, course and distance control their lines.

Opinions of Surveyors as Experts.

The Court of Civil Appeals of Texas holds, in the case of Angle v. Young (25 Southwestern Reporter, 798) that opinions of witnesses are admissible upon subjects with which they are, as experts, peculiarly acquainted, and which could not be made known to the jury except by expert testimony, and that this applies to surveyors. Here there were calls for unmarked trees in certain original surveys, which were designated by their species, size, and course and distance, from the corners. And it is held that it was proper to permit a surveyor, as witness, to show that there were trees of the same species, about the proper distance and course from the corners found by him; and that it was also proper to allow the surveyor to testify as to how there might be a slight discrepancy in the bearing of the trees as shown in the original surveys and as he found them on the ground by a variation in the needle.

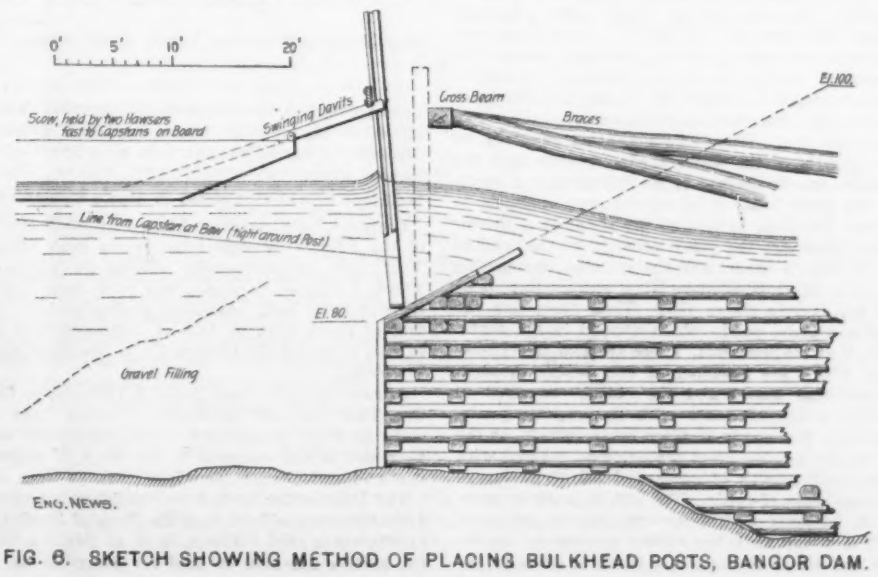


FIG. 6. SKETCH SHOWING METHOD OF PLACING BULKHEAD POSTS, BANGOR DAM.

CANALS AND LAND DRAINAGE AND RECLAMATION IN FLORIDA.

By J. Francis LeBaron, M. Am. Soc. C. E.

Florida lands are divided into four general classes, scrub, pine, hammock and swamp. The scrub lands are high, dry and sandy, with a thin and poor soil and covered with a growth of small hardwood bushes. These lands are never overflowed. They lie at an elevation of 4 or 5 ft. to as much as 200 ft. above the sea.

The pine lands comprise the principal portion of the state and are generally level, but in the western and central portion they are rolling. The soil of the pine lands varies from the thin, black mold, underlaid with white sand, and in some cases clay, of the flat pine barrens to the yellow sandy mold of the rolling pine lands, which is considered very suitable for orange trees. The flat pine woods are often overflowed in low places for several weeks during the rainy season and they abound with ponds, generally filled with cypress trees.

The "hammocks" of Florida are peculiar to the state. Any lands not swampy covered with large hardwood trees are called hammocks, or hummocks. The soil of the hammock is generally rich and productive and of a brown or black color.

The swamp lands are next in extent to the pine lands. At the time the public land surveys of Florida were made all swamp or overflowed lands were given to the state by the general government. These lands were made to include not only the swamps proper, but also all the flat pine woods which were wet and sloppy during the rainy season, and thus by far the larger half of the state was classed as swamp, although it is a fact that very much of this land is never even wet, but, on the contrary, requires irrigation to raise oranges and other crops. This is the character of a large proportion of the 4,000,000 acres sold by the state to the Disston companies.

This too broad interpretation of the act granting to the state "all swamp or overflowed lands" has reacted upon the state by establishing a reputation of having eight or nine-tenths of its area in swamp, and it is an undoubted fact that this classification partook of the nature of a land grab from the general government, the agents selecting the lands being appointed and paid by the state. The total area of Florida is 58,680 sq. miles, of which 4,440 sq. miles is water surface and probably about three times this area swamp land, properly so called, although 33,701 sq. miles have been classified officially as swamp and overflowed lands, and nearly all of it has been patented to the state. This does not include the yet unsurveyed lands in the Everglades and neighboring portions of the state, which amount to 4,629 sq. miles more. There are also in the southern part of the state great tracts of prairie land, which are overflowed in the rainy season from a few inches to one or two feet. These lands are included in the classification of swamp and overflowed lands.

The swamp lands proper of Florida are of several kinds. There are the swamps bordering the rivers, which are subject to the rise and fall of the streams. As a general thing these swamps cannot be drained, except by embanking and pumping, or only partially drained during the low-water season, at which time a quick-growing crop might be raised. There are also the large swamps and morasses, in which many of the rivers take their rise. These swamps, being generally on the summits of the water sheds, or very near the summits, can be drained by straightening and lowering the river beds, or by cutting new channels in another direction, to take off the water by a shorter route. Such are the great morasses at the head of the St. John's River, and the swamps surrounding the lakes where Kissimmee River and the Suwannee and St. Mary's rivers rise. Then there are the large saw-grass ponds which abound in the southern half of the peninsula. There are also the cypress ponds which are interspersed everywhere throughout the pine woods and the "bays," so-called in Florida, which alternate with the cypress ponds. There are also many shallow lakes, which, in the dry season, become great dry prairies, covered with a luxuriant growth of grass and afford pasturage for large herds of cattle. The soil, or muck composing the bottoms of these swamps, ponds and bays, is all deep and rich, but varies somewhat. In the river and creek swamps this muck is often of immense depth. A small swamp in the city limits of Jacksonville, bordering McCoy's Creek, which is crossed by the Savannah, Florida & Western R. R., required the piles for the railroad trestle to be spliced together for a length of 130 ft. before reaching solid bottom.

The cypress ponds and bays generally have a depth of muck of from 5 to 10 ft., and the saw-grass ponds, prairies and grassy lakes have a depth of rick black humus of from 18 ins. to 8 and 10 ft. In some localities this soil is underlaid with white sand and in others with clay or marl or soft phosphate. Some of the small grass ponds have only a few inches of muck.

The various analyses of these soils and the highly successful experiments in draining and cropping

Map Showing Swamps, Lakes, Waterways, Etc., of Florida.

them prove without a shadow of doubt that they are all extremely rich in plant food and eminently adapted for agriculture, as soon as relieved of the surplus water.

Drainage Works Completed or Under Construction.

Comparatively speaking, but a very small fraction of the Florida swamps have as yet been drained. There are, however, some notable exceptions, of which I propose to speak, and with nearly all of these I have been connected professionally. The first of these, both in date of commencement and extent, is one of the Disston Co.'s, described directly below:

Atlantic & Gulf Coast Canal & Okeechobee Land Co.—This company obtained a charter from the state in 1881, commenced operations in the same year and is still engaged in the work of reclamation and agricultural operations.

The Disston Co., it may be stated here, purchased 4,000,000 acres of land from the State of Florida for $1,000,000 in 1881. The A. & G. C. Canal & O. L. Co. receive one acre of land for every 25 cts. expended in draining. They are under contract with the Board of Internal Improvements to do not less than $40,000 worth of work per year. The price asked by the company for their drained lands is $75 to $100 per acre, and these lands have no subsidiary drains or ditches. These must be made by the purchaser.

A canal 15 miles long, 25 to 46 ft. wide and 4 to 7 ft. deep has been cut from Lake Okeechobee to Lake Flirt and the channels in the lake have been deepened to Fort Thompson, about three miles more. Canals 36 ft. wide and from 4 to 6 ft. deep have also been cut from Little or East Tohopekaliga to Tohopekaliga and from thence to Lake Cypress and Lake Hatchineha; also from Lake Hatchineha to Lake Kissimmee, and from Lake Cypress to Lake Kissimmee. The length of these canals aggregate eleven miles, and about two miles of cut-offs on the Kissimmee River, and much of the work consists simply in straightening, widening and deepening channels or channeling the bottom of the lakes. These lakes are all large. Okeechobee covers an area of over 1,000 sq. miles; Lake Hickpochee is 5 × 6 miles; Kissimmee, 6 × 15; Tohopekaliga, 12 × 3; Little Tohopekaliga, 4½ × 4½; Hatchineha, 2 × 7, and Cypress, 3 × 4 miles.

There are numerous other large lakes connecting with these. The drainage area of this territory is 6,300 sq. miles, and the annual rainfall is about 60 ins. The fall from Lake Conway to the level of the gulf is 106 ft. and the distance via the Kissimmee River, Lake Okeechobee and the Caloosahatchie River is about 300 miles. This will give an idea to an inquirer of the size of canal required to drain this immense territory, and the application of any hydraulic formula shows that several canals of the size constructed will be found necessary, if the water is to be promptly removed. As might have been expected, a canal 45 ft. wide by 6 ft. deep proved totally inadequate to relieve this immense area. We find in 1887 that the State Commissioner appointed to examine the work done by the company reported the canals entirely inadequate and the country overflowed. Since that time the canals have been widened a little and a new one, 50 ft. wide, 10 ft. deep and about 6½ miles long, dug from Lake Hart to the Econlochatchee, which empties into the St. John's River. They state that they have also commenced a canal southward from Lake Hickpochee, which will be about 70 miles long when completed.

This company has several acres of reclaimed land near the summit of its work under cultivation in sugar cane, and has erected a large sugar mill, and very good crops have been made, but it appears that the drainage question is still giving trouble, as it was reported in the summer of 1892 that 100 acres of cane was damaged by the overflow. The territory to be operated on by this company may be grouped into three general divisions, the upper, or lake regions, the northern Everglades and the southern glades. Lake Okeechobee is 20.24 ft. above mean tide in the Gulf of Mexico; Lake Tohopekaliga, near Kissimmee City, is 64.59 ft., and Lake Lockapapka, near Fort Clinch, 116.63 ft., all as shown by the levels taken by my party on the survey for a canal from St. John's River to Charlotte Harbor in 1881.

The lower glades are elevated only from 20 to 5 ft. above the sea, and less at the shores.

The extent of the territory operated on by this company is 115 miles east and west and 226 miles north and south. There is no doubt but that 80% of this territory can be efficiently drained by a sufficient number of judiciously-located and properly-dimensioned canals. The company appears to have worked for the last twelve years entirely on the tentative system, instead of first constructing their canals of the size required, as shown by well established hydraulic formulas.

No physical surveys or observations, other than a few soundings and reconnaissances, have ever been made, except those made under the direction of Colonel Meigs, Captain Williams and myself for the U. S. government.

The result is, after twelve years of desultory work, it is still in the experimental stage as regards drainage, but the great fertility of the soil has been proved beyond all question. The president of the company stated that in 1893 6,000,000 lbs. of sugar would be made, besides which the company had 1,500 acres in rice, which yields from 50 to

75 bushels of rough rice per acre per year. The sugar cane yields 30 tons of sugar per acre. Excellent tobacco is grown there, also peaches and garden vegetables. The company has opened up 250 miles of steamboat navigation, but there is still a feeling of insecurity about the drainage, arising from the lack of scientific and systematic treatment. The company cuts its canals in the same way that Captain Eads said the army engineers built their jetties—30 ft. one year and the next year go over them and cut out 30 or 40 ft. more in width.

In the message of the Governor of Florida in 1889 references were made to the numerous complaints of the inadequacy of the Disston drainage canals, and it was stated that the company had been forced to widen its canals for the third time. Of course this necessitated a re-handling of all the earth thrown out of half of the canal prism previously dug. And it appears that even this is not sufficient, by the reports of last summer's floods. A judicious application of Kutter's or Hagen's* formula, applied externally for a few months, would have promoted a healthy activity of the system and acted as a mild cathartic.

Santa Fe Canal.—This is the name given to the several short cuts which have been made, connecting the Santa Fe River, South Pond and Santa Fe Lake, aggregating a few miles only. These canals were built both for navigation and drainage, and small bodies of saw-grass bordering the lakes have been reclaimed and converted into rice fields and truck farms. Mr. N. E. Farrell, now in Central America, was the engineer.

Apopka Drainage Co.—This company is engaged in enlarging and deepening the stream between Lakes Eustis and Dora, about one mile, for the purpose of navigation and drainage. This is expected to drain a large tract of land suitable for sugar cane and rice, and hundreds of acres in Lake County. This will make a complete navigation for lake steamers from Lake Apopka, through Lakes Ola, Sams, Beauclerc, Dora, Eustis, Harris and Astabula, down the upper Ocklawaha to Lake Griffin.

Its work was examined by the State Engineer in 1887, and in the message of the Governor of Florida for 1889 it is shown that it is having the same troubles with its canals as the Disston Co.—in the rainy season they proved to be too small.

Delta Canal & Drainage Co.—This company has cut a canal from Lake Dora to Lake Apopka, which is the head of the Ocklawaha River. Its length is about 6½ miles, and it was made by deepening, widening and cutting off bends in the Ocklawaha. The company expects to drain 20,000 acres of saw-grass land.

Tsala Apopka Canal.—A canal about three miles long and 50 ft. wide has been dug from this lake, in Citrus Co., to the Withlacoochee River for the purpose of navigation and drainage. It is not deep enough to be of use, except during seasons of high water.

Sarasota Sawgrass.—In 1886 I was consulted in regard to the drainage of this land. The drainage of this saw-grass pond was done by the Florida Mortgage & Investment Co., Ltd. The work is situated about three miles east of Sarasota, in Manatee Co. The drainage line was down Phillips Creek to tide water, and the fall was 6.5 ft. in a distance of 7,000 ft. The canal was 3,000 ft. long, and the creek was widened, deepened and straightened for a distance of 4,000 ft. more. The main ditch is 12 ft. wide on top, 6 ft. on the bottom and 4 ft. deep. The area of the saw-grass pond is 500 acres, and the drainage area 3,500 acres. The work was done by negroes with shovels, and cost, all told, $6.30 per acre.

During the rainy season Phillips Creek has proved incapable of carrying off the water discharged into it from the canal, owing to its slight fall and crookedness. The land has been laid out into five-acre lots, with a ditch 3 ft. wide and 3 ft. deep all around each lot. The bottom of the pond is level. The main ditch was completed in June, 1886, and in the fall of the same year the land was plowed by oxen. Horses could not be used, as it was too soft, but in December it had become sufficiently hard for me to ride my horse all over it. The soil is a black, mucky peat, 3 ft. deep, underlaid with sand and marl, and has proved very fertile and productive.

Florida Muck Land Co.—This company is operating in Bradford Co. It has 4,500 acres of land bordering on Sampson, Crosby and Rowell lakes, and has dug two miles of canal 40 ft. wide by 8 to 10 ft. deep. Sampson Lake is about 2½ miles in diameter; Crosby, 2 × 1½ miles, and Rowell about the same. There are 3,000 acres of muck land. The soil is 3 to 16 ft. deep, with clay subsoil. It is a decomposed vegetable mold, very rich and productive. A small (No. 4) steam dipper dredge was used, and made 50 ft. of canal per day on the average.

Peaches, grapes, figs, pears, oranges, corn, sugar-cane and rice are raised to perfection; 100 bu. per acre of the latter have been raised. Three years ago this land was covered with 2 to 4 ft. of water.

The Suwannee Canal Co.—This is a Georgia company, which is operating in Georgia, just across the Florida line, and is engaged in draining that part of the great Okefinokee swamp that is situated in Georgia. About one-third of this swamp lies within the state of Florida. The Georgia part contains 676.55 square miles, and the drainage area is 1,262 sq. miles. The elevation of the northern portion of the swamp is 125 ft. above low tide, and at the southwest corner, where the Suwannee River begins, the elevation is 107.5 ft.

In 1891 I was consulted and asked to devise a system for draining this swamp, which I did, and the company is now engaged in the work as outlined by me, which is proving very successful. The swamp is bounded on the east side by a sand ridge 30 ft. higher than the edge of the swamp. By cutting through this ridge to the St. Mary's River a canal has been made with a fall of about 118 ft. in a distance of seven miles. This company has a large and powerful dredge, fitted at one end with a dipper and at the other end with a centrifugal pump and suction pipe. The main canal is nearly completed from the edge of the swamp to the St. Mary's River, and is being washed out by the current from the swamp. The dredge is working into the swamp, and has progressed over a mile and a half, and is within two miles of a very fine body of cypress timber. This timber is the first object to be attained, and will be floated down the canal to tidewater. For this reason it was necessary to dig the canal the whole distance to the St. Mary's River, otherwise for drainage alone it would only have been necessary to cut through the confining ridge of sand and let the water find its own channel to the river thereafter.

This swamp presents the appearance of a great prairie, covered with about 2 ft. of water, sometimes dried up to a few inches, full of lilies and other aquatic plants, and dotted with large bodies of cypress timber and numerous islands covered with cedar. The soil consists of 5 to 7 ft. of rich vegetable mold, underlaid with sand and clay. At the top this mold is very fibrous and spongy.

Capt. Harry Jackson, of Atlanta, is the president of this company, and a Mr. Hall is Chief Engineer.

Florida Coast Line Canal & Transportation Co., H. M. Flagler, President.—This company was chartered in 1881 to build a navigable canal along the east coast of the state. It will be all in tidewater and will not effect any drainage of consequence. Some hundreds of acres immediately bordering the canal, which were awash, have had the water lowered a foot or two, so that they can now be cultivated. The company has opened a canal between Indian River and Mosquito Lagoon, about half a mile long, and has done some work between Matanzas and Halifax rivers. It was originally chartered to build a canal from the St. John's River to Biscayne Bay, 370 miles. In 1882 I was consulted on this route, and examined and surveyed a large portion of it. The company has a land grant of 300,000 acres from the state.

Projected Drainage Works.

Miccosukee Drainage Co.—This company, of which Mr. W. G. Denham, of Monticello, Fla., is president, owns 9,825 acres in Jefferson Co., Fla., being the whole of Miccosukee Lake. This lake is about 6½ × 3½ miles, with an arm about 10 × 1½ miles. The main body of the lake is open, but the arm is heavily timbered with cypress and black gum. The lake is 6½ ft. deep at high water, with a creek or gully in the northern part which is 4 to 30 ft. deeper.

There are several sinks in the bed of the lake and in the outlet into which the waters of the lake empty. These sinks lead to underground cavities and channels in the rotten limestone, which underlies this part of the state. The water pours into these cavities, to rise again as a river or immense spring many miles distant. The bottom of the lake is almost perfectly flat and the soil consists of a very rich black muck, from 2 to 8 ft. thick, underlaid with various colored clays, kaolin and phosphate.

In 1892 I made a careful survey and physical examination, with plans and estimates for draining the lake, which I found to be perfectly feasible at small expense. The only question is whether the "sinks" will have capacity enough, after they have been cleared out, or blown up with dynamite, as I proposed, to discharge the waters of the lake's drainage area before any harmful engorgement or overflow should take place. This question could only be settled by experiment. In case of their incapacity, the water can be discharged into the head of the St. Mark's River by extending the canal about two miles, half of which will be simply widening, deepening and straightening existing water courses. The fall of the main canal will be 6 ins. per mile.

Leaving out the arm of the lake, it will require for the drainage of the main body of the lake 7¾ miles of canal, with a surface width of 83 ft.; bottom width, 71 ft. and 6 ft. depth. This is the width at the lower end, and will gradually decrease towards the upper end. There are four streams which enter the lake proper, and six which empty into the arm. These streams nearly all dry up in the summer and the lake often becomes entirely dry. When I commenced my survey the bottom of the lake was so dry that I walked all over it.

There will be five branch canals to take the water from these streams and the arm to the main canal, their aggregate length being a little over four miles. The drainage area is 229 sq. miles, including the lake. The mean annual rainfall is 55.89 ins. and the evaporation 49.5 ins., as given by the U. S. Weather Bureau. The size of the canals is, however, determined by using the mean of the monthly maxima rainfall for a series of years, corrected by the evaporation. The excessive rainfalls of short duration were disregarded, as a few hours' overflow, once in a dozen years, was not considered objectionable enough to warrant the increased expense incurred by the necessary enlargement of the canals.

The plan included a dam, with movable gates, across the arm of the lake, in order to flood it when required to float out the timber, and a gate across the outlet canal in order to flood the lake when required for irrigation.

San Sebastian Sugar, Land & Investment Co.—In 1891 I was consulted and prepared plans and estimates for draining this tract, but the company has never done anything more. This company's lands are situated in Brevard County, at the headwaters of the St. John's River, and comprise 112,000 acres. About two-thirds of this is saw-grass, the balance prairie. On the west side three streams flow into this tract. During the rainy season these streams are very wide, 600 and 800 ft. and over, but shallow.

All the land for miles around is very level, and the St. John's River, which issues from this tract, falls only 3.26 ft. in 23 miles, to Lake Winder.

The elevation of this tract is 22 ft. above tide water. The drainage will be into the San Sebastian River, which empties into the Indian River, and the length of the main outlet canal will be 18 miles. The length of the two branch canals will be 95 miles, and the intercepting canal, round the boundary, 60 miles. The drainage area is 468 sq. miles.

If we lower the water level 3¼ ft. on this tract, this lowering will extend down stream to Lake Winder, 28 miles, and the flow of water in the Upper St. John's, Saw-Grass Lake and Lake Washington will be reversed and will discharge through the drainage canal and the drainage area will be more than doubled. To prevent this it will be necessary to built a levee all around the tract. This levee would be 51½ miles long. Otherwise it will

* See Schlichting. Improvement of Navigable Non-Tidal Rivers, Leipsic, 1882, p. 42.

be necessary to dig other and independent outlet canals, outside of the company's property.

The annual rainfall is about 63 ins., of which 11-12 falls in the summer months. The evaporation is about 30 ins. in a season. The land is all so watersoaked and flat that the infiltration will be very large, being estimated at 5 cu. ft. per hour per lineal foot of canal. This tract is located in the garden section of the state, where nearly all kinds of tropical fruits can be raised to perfection and the soil is of the richest and most fertile quality.

The difficulties of draining this tract alone out of all the immense area of overflowed lands by which it is surrounded are so great that the cost will be over a million dollars. If united action could be had to drain the whole of the St. John's Valley above Lake Harney, it could be done by a number of independent canals emptying into the Indian River, and so no levees would be required. The Atlantic & Gulf Coast Canal & Okeechobee Land Co. claims all but one township of the San Sebastian Sugar, Land & Investment Co.'s land as being within their drainage territory.

Gulf Coast Canal.—This scheme was similar to that of the Florida Coast Line Canal & Transportation Co., noted above. It was proposed to open an inland navigation route to run from Tampa to Punta Rasa, 132 miles, and to connect the tidal bays and estuaries behind the keys. The aggregate length of the working sections of this canal is 18¼ miles, and the deepest cut 14.3 ft. The canal prism adopted was, base, 60 ft.; depth, 4 ft.; side slopes, 1½ to 1. I made the surveys, plans and estimates for this canal and harbors in 1885. It will cost very little, and will open up a fine section of country. Nothing has been done on it, however.

Florida Ship Canal & Transit Co.—This company was chartered in 1883 to build a ship tide-level canal across the peninsula of Florida. I was the resident engineer in charge. The route adopted was from the mouth of the St. John's River to Dead Man's Bay on the Gulf of Mexico. The deepest cut was 143 ft., and the total length of canal 137½ miles. Incidentally it would drain a great many swamps. Nothing was ever done by this company, except to incur a large indebtedness for surveys, which it never paid.

Other Works and Projects.—The construction of a canal was commenced before the war from Lake Harney to the Indian River. The work was abandoned on the breaking out of the war and has never been resumed.

Paine's Prairie, about 7½ × 2 miles, near Gainesville, was once a lake. A few years ago a large "sink" at one end of the lake reopened, and the water all disappeared in the bowels of the earth; the lake was thus drained, and its bed is now under cultivation.

Lake Iamonia, 7 × 2½ miles, in Leon Co., often runs dry in the winter, the waters disappearing in "sinks." It is proposed to permanently drain it.

The great Turnbull Swamp, near New Smyrna, was largely drained by the Minorcans, a colony from the Island of Minorca, 125 years ago. The canals and ditches are now plainly to be seen, but choked up with mud and aquatic plants. Great crops of sugar cane and indigo were raised on these drained lands.

Prehistoric Canals.—These are found in numerous places in the state, and are supposed to be the work of the Indians. Remains of levees are found on the Kissimmee River and a canal exists cut clear across Pine Island in Charlotte Harbor.

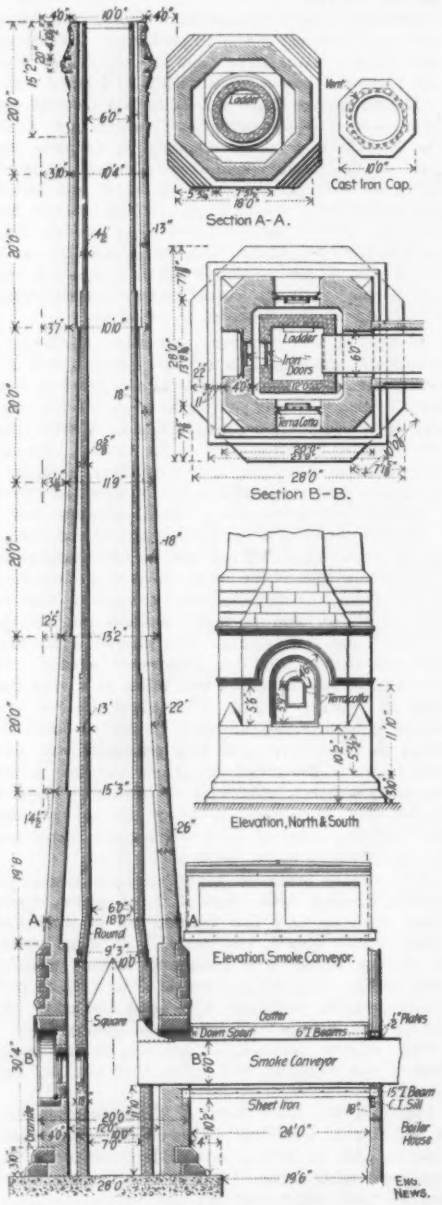
From Lake Flirt, in De Soto Co., a canal over 3 miles long and about 20 ft. wide and 3 ft. deep extends through the pine woods in a northeast direction to a group of large Indian mounds. I personally inspected this work. The excavated earth is plainly to be seen on the sides. Large trees, 60 to 70 years old, are growing in the bottom of the ditch.

Numerous other places might be mentioned. A large number of swamps and lakes still remain in Florida, from 200 acres to over 200 sq. miles in extent, that are not covered by any of the existing charters for drainage, but which can readily and profitably be drained, and would render available the richest and most fertile soil, suitable for the cultivation of sugar cane, rice, tobacco, corn, bananas, strawberries and all varieties of vegetables and melons. These lands can be obtained at merely nominal prices from the state.

NEW CHIMNEY FOR THE ST. LOUIS WATER-WORKS.

An interesting chimney was completed last October in connection with the low service extension of the St. Louis water-works, after designs made in the office of the extension, under the direction of the water commissioner, Mr. M. L. Holman, M. Am. Soc. C. E. We are indebted to Mr. S. Bent Russell, M. Am. Soc. C. E., assistant engineer in charge of the extension, for the accompanying illustration and information regarding the structure.

Mr. Russell states that he believes the chimney rather high, 150 ft. over all, for its capacity, the



Chimney for the Low Service Extension of the St. Louis Water-Works.

extra height having been made necessary by a high bluff to the west. The foundation is a solid octagonal prism built of large stone bedded in concrete and rests on solid rock at a depth of about 28 ft.

A cross section, several sectional plans and a partial elevation of the base of the chimney are shown by the accompanying cut. The core or lining of the chimney is of firebrick laid in cement and the remainder is built of red brick, laid in Portland cement, with Lake Superior red sandstone trimmings at the base, and a cast iron top.

A tracklaying machine is said to be in use on the construction of the Chicago, Paducah & Memphis R. R., between Marion and Mt. Vernon, in Southern Illinois. It will probably be a surprise to many engineers to learn that any railway is laying enough tracks this year to make any use of such a machine.

THE COPENHAGEN BREAKWATER.

As already described in this journal of April 6, 1893, Copenhagen was made a free port in March, 1891. This action of the government made necessary the deepening of channels, the building of docks and warehouses and the construction of a breakwater. There is no tide at this point, strictly speaking, the only variation in water level being caused by the prevailing direction and duration of the wind, and this variation runs from about 3 ft. below to 3 ft. above the mean level during the year.

Omitting the general description of the port, as described in "Nouvelles Annales de la Construction"—as this is already shown in the map given in our own article referred to, the breakwater construction protecting the entrance to the port may be described as follows:

The depth of water below mean level is about 12 ft. over a length of 790 ft. and about 25 ft. over the remaining length of 780 ft. This greater depth was the result of several years' dredging before the plans for the actual work had been completed. The cross-section of the breakwater in the shallower water is shown in Fig. 1. Here the blocks of beton rest upon a foundation of broken stone 2 ft. deep, leveled off by divers at 10¼ ft. below mean water level. Each beton block is 10¼ ft. high and has a length of 7¼ ft. on the axis of the breakwater, and a thickness of 10¼ ft. The superstructure resting upon these blocks is built of roughly-quarried granite blocks, and the wall is about 6 ft. thick, rises 6 ft. above mean water, and has a batter of 1 to 1 on part of the outer face, as shown. The mortar used in the parapet wall was made 1 part

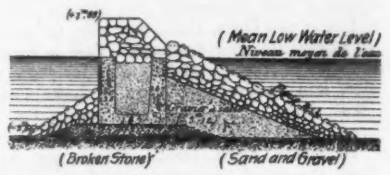


Fig. 1. Cross Section of Breakwater in 12 ft. Depth.

Portland cement to 2 parts sand in the face and 1 to 3 parts sand in the interior.

On the outer face of the breakwater is a slope of gravel, rising to within 3 ft. of the datum line, and this is then covered with a bed of flinty cobblestone, 1 to 2 ft. thick, and on this a face of rough granite blocks. This slope has a batter of 2 to 1 and rises 3 ft. above the mean water level. On the inner side of the breakwater is a shorter slope, as shown, made of the flint cobblestones referred to. The thickness of the parapet wall was made equal to its height, in view of the shock from floating ice. A floating 50-ton crane was used in putting the blocks of beton in place.

As it was not deemed practicable to handle blocks exceeding 35 to 40 tons in weight, nor to shorten the length of the blocks, those intended for the deeper water were made hollow, with transverse ties of wire netting and mortar on the Monier system. Each of these blocks weighed about 39 tons on a length of 7¼ ft. The wall was built up in two courses, breaking joints, and the interior space was filled with sand, weighing about 53 tons more for each block. The walls of the hollow blocks are about 2.3 ft. thick, and the distance between the Monier partitions is 5.9 ft., the partitions being 2½ ins. thick. These beton blocks were made with 1 part Portland cement to 4 parts of sand and 7 of broken stone; a mixture in the proportions of 1, 3 and 6 was used for the interior wall and about 3 ft. of the top of the exterior wall.

For better resistance against wave and ice action, 3 ft. of the exterior wall and 6 ft. of the interior wall are covered with a parapet of cut granite blocks set in a mortar of 1 part Portland cement to 2 of sand. The Monier connecting plates have a width of 5.64 ft. to a height of 9.25 ft. and a thickness of 0.2 ft., or 2½ ins. The mortar used in them is made of 1 part of Portland cement to 3 parts of sand. The iron network in the middle of the plate is constructed of round horizontal and vertical rods, spaced 2¾ ins. c. to c. of rods, and tied together at the crossing points by iron wire. The vertical rods have a diameter of 0.21 in., and the

horizontal rods have diameters of 0.28 in. and 0.40 in., two of the first size alternating with two of the second. These horizontal bars pass the end limit of the plate by a short distance and the ends are alternately bent to the right and to the left, thus tying the net-work solidly to the beton in the blocks. These Monier plates were made upon a plank platform and allowed to set for at least one week before they were put into the beton blocks.

The main blocks were formed in molds of 1¼-in. planks upon a plank platform. Each mold was made up of four exterior frames and two interior frames, united by means of wedges. The two inside frames descended to the bottom of the cavity only; but the four posts upon which they stand pass through to the bottom of the block and leave four holes, by which the block is lifted. Through these holes pass four 2-in. steel rods (Fig. 4), the bottom heads of which do not press directly upon the beton, but upon blocks of wood resting upon the top of a little wooden box let into the bottom of the block, and thus leaving a space sufficient to turn the key and release the rod. A framework of angle iron, placed on the top of the block before lifting by the crane, keeps the rods in a vertical position. These beton blocks are made at least three weeks before being put into place. At the time of writing six blocks per day placed in position was the maximum day's work.

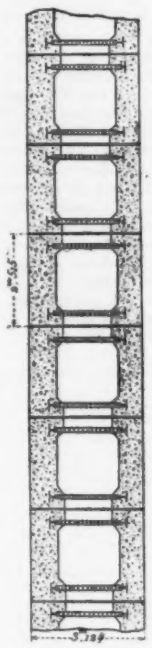


Fig. 2. Plan of Beton Blocks.

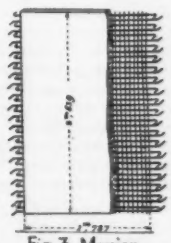


Fig. 3. Monier Connecting Plates.

Fig. 4. Device for Lifting Beton Blocks.

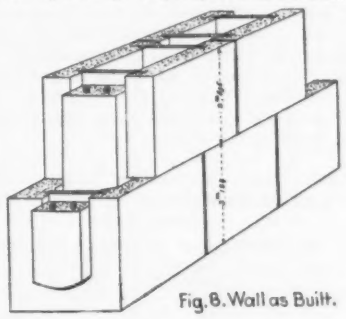
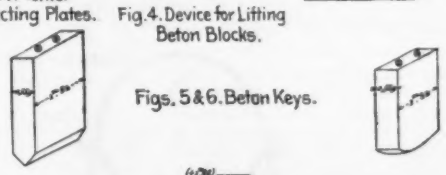


Fig. 8. Wall as Built.



Figs. 5 & 6. Beton Keys.

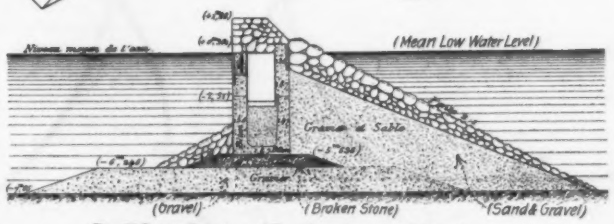


Fig. 7. Cross Section of Breakwater in 25 ft. Depth.

The Monier plates are fixed in the blocks about one foot from the ends, and the 2-ft. space left between the plates in adjoining blocks is fitted by specially molded blocks, weighing about four tons each, which act as keys in keeping the wall in line, as these keys break the vertical joint and the keys in the upper course descend about 18 ins. below the tops of the lower blocks. No mortar is used in setting these keys, as this is practically impossible, and it is thus made more easy to some day tear down the breakwater should it ever be found necessary to increase the area of the port. For the latter reason also the lifting holes are plugged with wooden plugs before the sand filling is put in place.

The cross section of the deep water wall is shown in Fig. 7. By throwing down fine gravel, obtained from dredging, the depth of water was reduced to 20½ ft. Upon this gravel was placed 2 ft. of broken stone immediately supporting the beton blocks. The interior and exterior protecting slopes are practically the same, except in dimensions, as those described for the lower wall.

A steel dam 100 ft. high, according to the California papers, is to be built across the Santa Ana River. The report states that riveted steel plates will be used, reinforced by steel columns "anchored in bedrock."

THE COPENHAGEN BREAKWATER.

UTILIZATION OF PEAT IN EUROPE.

Peat is largely used in Europe for fuel and other purposes, and some particulars respecting this material are given by Mr. Louis Stern, U. S. Commercial agent at Bamberg, Germany, in a recent consular report. The peat is cut by spades and dried in the open air or in kilns and pressed or molded into bricks. Ball peat consists of globes of turf about 4 ins. in diameter, made by passing the turf pulp through specially contrived appliances. In the peat works at Haspelmoor and Kalbermoor, the moor to be worked is first freed from vegetation, leveled, plowed and harrowed and loosened peat broken, so as to be exposed to the action of the air. It is then gathered by a machine and taken to the separating machine, thence to the drying oven and the press, whence it issues in the shape of a smooth, shiny, dark-brown bricks. A machine (the Schlickeysen system) in operation at Haspelmoor produces, provided suitable raw material is used, from 10,000 to 15,000 bricks in ten hours. Another machine (manufactured by Henry Clayton, Son & Howlatt, London), requiring 6 HP. to operate it, can produce from 60,000 to 100,000 bricks per day. Those contemplating the construction of peat works should never lose sight of the fact that from the very beginning every prolonged and expensive kind of manipulation is to be avoided.

In Germany the relative cost of peat, as compared with hard coal, is as follows: 220 lbs. of good Zwickau hard coal cost at the mine 28.56 to 38.56 cts., while the cost of production of the same quantity of peat amounts to from 8.14 to 33.32 cts., according to quality.

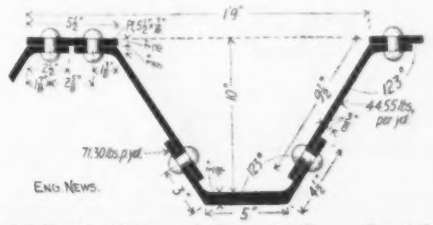
Besides its use as fuel, peat is turned to account in Europe as a fertilizer and as building material, it being used successfully as a filler for vacant spaces, separating layers for water-works, reservoirs, ice houses, etc. By means of a process patented by a tanner in Mayence it has also been made to do service in tanneries. The waste or superfluous particles of peat, known as "peat dust," have recently been brought into extensive use as a material for fitting up and preserving odorless vaults, an innovation deserving strong commendation, especially in localities where the sewerage is inadequate.

In Europe the countries that possess the most extensive peat bogs or moors are Ireland, Scotland, Sweden, Norway, Denmark, Eastern and Western Russia, Holland, Austria, Hungary, Prussia, Bavaria, Hanover, Oldenburg and Mecklenburg. Hanover and Mecklenburg alone have from 140 to 150 sq. miles, and Bavaria has 22 sq. miles of peat moors. The territory of the United States embraces very extensive peat bogs.

SOLID FLOOR SYSTEM, FRONT ST. VIADUCT, COLUMBUS, OHIO.

We illustrate herewith the solid floor system for the Front St. viaduct at Columbus, O. This viaduct is being constructed to carry the street traffic over the tracks of the Pittsburg, Cincinnati, Chicago & St. Louis and Cleveland, Cincinnati, Chicago & St. Louis railways, and consists of two skew spans 161 ft. 6 ins. long each, carrying two roadways, two street railway tracks, and two sidewalks. Each span consists of three trusses placed 30 ft. apart c. to c., and the roadway and street railway tracks are carried between these trusses, with the sidewalks supported by brackets on the outside of the bridge. In addition to the skew of 23° the bridge is 3 ft. higher at the center pier than at the abutments, which necessitated putting the horizontal planes of the end pins of the trusses at different heights from the level bridge seats in order that the curb level on a right angled section might be the same. This change in elevation is effected in the design of the shoes. The entire bridge is of basic open hearth steel, having an ultimate strength of from 54,000 lbs. to 62,000 lbs. per sq. in.

The construction of the floor system is shown by the drawings. A system of steel buckle plates



Solid Buckle Plate and Concrete Floor, Front St. Viaduct, Columbus, Ohio.

is carried by the floor beams and girders, and upon this is placed a layer of concrete as a foundation for the pavement. The pavement is of brick laid on sand on the concrete. Other details of the construction are shown by the drawings. The bridge was designed by Mr. Jos. Kinnear, City Engineer, Columbus, O., and the contractors for the steel work were the Edge-Moor Bridge Works, of Wilmington, Del. We are indebted to Mr. Kinnear for the drawings from which our illustration has been prepared.

A NEW SOLID METALLIC BRIDGE FLOOR.

The Gaspee and Promenade Street bridges now being erected at the new Terminal Station, in Providence, R. I., by the Berlin Iron Bridge Co., presented some local difficulties that have resulted in the adoption of a design for a solid metallic floor that is somewhat different from previous designs, though it is a combination of well known shapes.

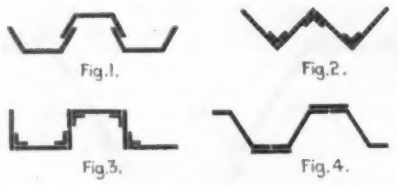
Each bridge is about 250 ft. long and 70 ft. wide, carrying 12 tracks and passenger platforms. Both are very near the new station building and they have a level top surface. A solid floor ballast bridge, of minimum thickness of floor, was determined upon, but the conditions required a possible change in location of tracks after completion and this condition, coupled with the large area of the bridge, made it impossible to so treat the structure as to shed the water falling upon it at the ends or sides, as usually done. It was, in fact, necessary that the water should go through the structure and yet not drip over the entire under surface.

A logical arrangement of girders for the purpose required that the floor troughs should be about 8 ft. long and supported at each end. To support the assumed load required a series of troughs about 10 ins. in depth. The deepest available rolled troughs with a tight bottom being only 6 ins., and even this having awkward features in shop construction, led to the design under construction, which is best described by reference to the illustration herewith. The particular merit claimed by the inventors for the combination is (1) simplicity in rolling, (2) adaptability to power riveting, (3) elimination of difficulty in accurate spacing center to center of shapes, (4) smooth base on which to rest, (5) avoidance of rivet holes in bottom or tension flange when treated as a girder, (6) water-tight bottom (which is the all-important factor in some cases), (7) a varia-

bility in height within reasonable limits while preserving all of the other features claimed for it.

The shapes are so placed that the water collected in the troughs is discharged at the ends and flows into gutters and down spouts placed for the purpose. The weight per square foot does not exceed that of the simplest forms now made of the same depth, which forms do not cover all the other named advantages. Letters patent on the above combination of shapes for bridge flooring have been granted to George B. Frances and E. P. Dawley, Resident Engineer and Division Engineer respectively on the Providence work, who have invented the combination.

The inventors furnish us with the following comparison of their shape with the shapes used by other engineers and we leave each designer to do battle for the merits of his own invention: It would at first seem that sufficient designs of floor shapes had already been invented, but a brief consideration will show that each one heretofore in use lacks some essential feature for the work of like character to that now under way in Providence. The common Lindsay form (Fig. 1) has only been successfully rolled in this country of a total depth of 6 ins., though this trouble may yet be overcome. If overcome it is claimed to be inferior to



the new design. It is also found difficult to space the shapes accurately, owing to slight variation in flare of troughs and there being no place to give and take. Difficulty is also experienced in using a power riveter on the diagonal lines.

The shape (Fig. 2), invented and patented by D. H. Andrews, of the Boston Bridge Works, lacks the positive watertight bottom, as does also the Thompson shapes (Fig. 3), though these may have other merits as to variation in height, etc. The shape (Fig. 4) of the Pencoyd Construction Co. also lacks the one essential of positive watertight bottom, as well as robbing the tension flange of valuable metal. None of these present shapes, except the Lindsay form, have a good seat for bearing on account of the rivet heads. Sufficient attention has not yet been given to ballast floor bridges in the item of drainage. The supporting of the ballast and deadening of noise have been looked after, but the prevention of drip and the annoyance therefrom has been almost entirely neglected, though incidentally it can readily be taken care of.

RESULTS OF PAVING BRICK TESTS AT ST. LOUIS.

The desirability of combining the results of the transverse, crushing, abrasion and absorption tests usually applied to brick so as to obtain a composite ranking of the various samples under examination is obvious to all, since the result of each of the above tests is not of equal importance. Some recent tests made by Prof. J. B. Johnson, M. Am. Soc. C. E., for the Board of Public Improvements of St. Louis, have been computed for rank by Messrs. M. J. Murphy, Dan Able and Robert E. McMath, M. Am. Soc. C. E., constituting the Committee on Street Department. The results of transverse tests, in thousands of pounds, were divided by two for composite ranking, and in the same way the results of the crushing tests were divided by four. The factor for the abrasion tests was taken as ten times the reciprocal of the result of the test, and for the absorption as one-fourth the reciprocal. The actual results obtained by Prof. Johnson and the results of the computations for composite ranking, together with the sums of the several results, which give the composite ranking, are presented for seven kinds of brick in the accompanying table. For easier study we have rearranged this table in order of composite ranking and there has been appended to it for each brick under each form of test its natural rank as compared with the others in that test, its composite rank for the four tests and the difference between these two. This difference, or the sum of these differences under each test, are designed to serve as some indication of which of the tests by itself comes nearest to indicating the desirability of a brick for paving, assuming the above basis of computation to be correct. According to the above results the abrasion tests come nearest and the transverse next, while the crushing test comes third and the absorption test fourth in the scale.

Results of Paving Brick Tests at St. Louis.

Results of various tests and conversion of same for composite rank.

Make of brick.	—Transverse.— Actual, 1,000 lbs.	Rank.	—Crushing.— Actual. 1,000 lbs.	Rank.	—Abrasion.— Actual, times granite.	Rank.	—Absorption.— Actual, per cent. volume.	Rank.	Composite rank.
Wabash Clay Co.	3.87	1.93	12.49	3.12	3.07	3.26	1.12	0.22	8.53
Mack Standard Repressed	4.19	2.09	12.09	3.02	3.88	2.58	3.40	0.67	7.76
Purington Paving Brick Co.	3.38	1.69	13.22	3.30	3.98	2.51	1.12	0.22	7.72
Galesburg Brick & Terra Cotta Co.	2.99	1.50	14.65	3.66	5.32	1.88	0.64	0.39	7.43
Moberly Brick Co.	3.53	1.76	13.02	3.25	4.56	2.19	1.56	0.16	7.36
St. Louis Pressed Brick Co.	2.69	1.34	13.19	3.30	5.11	1.96	0.33	0.75	7.35
Alton Paving & Fire Brick	2.57	1.28	11.06	2.42	7.37	1.36	0.87	0.29	5.35

Comparison of natural and composite rankings.

	Natural.	Composite.	Difference.	Natural.	Composite.	Difference.	Natural.	Composite.	Difference.	Natural.	Composite.	Difference.
Wabash Clay Co.	2	1	1	5	1	4	1	1	0	4	1	3
Mack Standard Repressed	1	2	1	6	2	4	2	2	0	6	2	4
Purington Paving Brick Co.	4	3	1	2	3	1	3	3	0	4	3	1
Galesburg Brick & Terra Cotta Co	5	4	1	1	4	3	6	4	2	2	4	2
Moberly Brick Co.	3	5	2	4	5	1	4	5	1	5	5	0
St. Louis Pressed Brick Co.	6	6	0	3	6	3	5	6	1	1	6	5
Alton Paving & Fire Brick	7	7	0	7	7	0	7	7	0	3	7	4
Sum of differences			6			16			4			19

CAST IRON INTAKE CRIB FOR THE WATER-WORKS OF SOUTH MILWAUKEE, WIS.

An unusual method of protecting the lake end of a water-works intake pipe has been adopted at South Milwaukee, Wis., by Dousman & Sheldon, of Milwaukee, engineers for new water-works at that place. The pipe is laid on the lake bottom, and in place of a wooden crib at its outer extremity the pipe is surrounded by a bell-shaped piece of cast iron and its mouth has a hemispherical strainer of cast iron, all as shown in the view, Fig. 1, and the section, Fig. 2. The cast iron strainer has 1,740 ½-in. holes, which give three times the area of the 12-in. intake pipe. The intake crib complete, as shown in Fig. 1, weighed 15,800 lbs., and cost about $450 delivered on the dock. It was easily lowered into place from a scow by means of a steam derrick. Several scow loads of boulders were placed upon the crib by means of a chute, being designed to protect the crib from

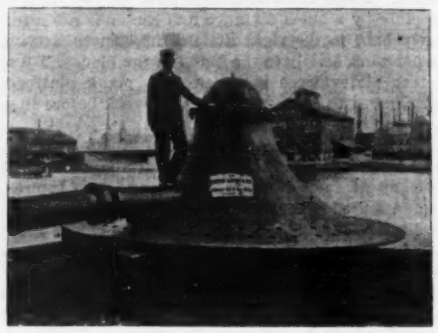


Fig. 1. View of Cast Iron Intake Crib, South Milwaukee Water-Works.

dragging anchors. The crib is in about 22 ft. of water, and both it and the whole intake pipe can be flushed from the pumps.

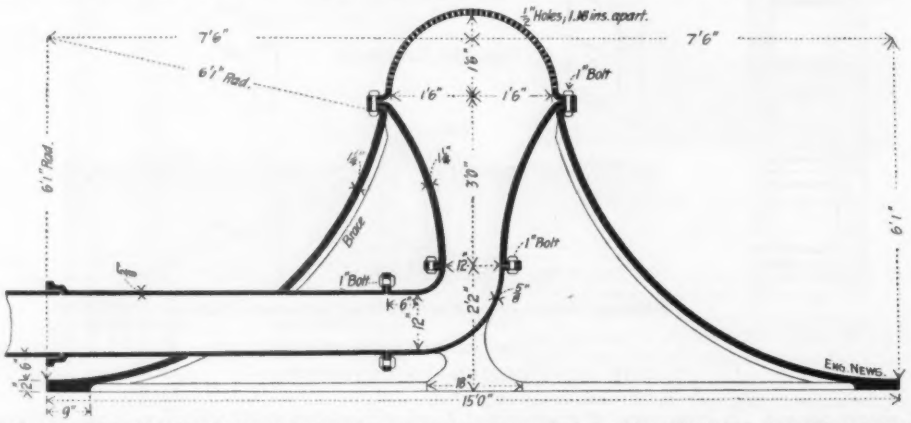


FIG. 2. SECTION THROUGH CAST IRON INTAKE CRIB, SOUTH MILWAUKEE WATER-WORKS.

Articles of incorporation were filed at Trenton, N. J., on July 13, for the Central New Jersey Traction Co. and the New York & Philadelphia Traction Co. These are trolley railway enterprises of large dimensions, the capital stock amounting to $10,500,000. The projectors propose not only a trunk line by the shortest route between New York and Philadelphia, but also a network of feeding and connecting lines. The main line laid down starts at Paterson, and passes through Montclair, the Oranges, Plainfield, Bound Brook, Millestone, Princeton, and Lawrenceville to Trenton. From Trenton the line practically follows the Pennsylvania R.R. to Philadelphia. The entire system will cover about 150 miles of electric railway. The two companies named are to build and operate the roads. The first named will have its headquarters at No. 2 Wall St., New York, and the second named company will have its offices located at Trenton, N. J. The officers of the Central New Jersey Traction Co. are President, F. A. Magowan, of Trenton; Vice-President, E. W. Hine, of Newark, N. J.; Secretary, J. H. Baldwin, of Newark, and Treasurer, Jas. H. Darrah, of Trenton. Mr. Magowan is also president of the New York & Philadelphia Traction Co. No time is set for the commencement of actual construction.

A chrome steel armor plate made for the Midvale Steel Co. is soon to be tested at the Sandy Hook proving grounds. The plate is 5 × 6 ft. in size and 10½ ins. thick. Two projectiles will be fired at it from an 8-in. rifle, at a velocity of 1,625 ft. per second, and if they fail to penetrate the plate, a third shot at a higher velocity will be tried. It is claimed that the plate has greater face hardness than the Harveyized nickel steel. Whether it has equal toughness remains to be seen.

The board of civil engineers of the Navy Department appointed to investigate the foundations of the Puget Sound dry dock has made its report. The contractor claimed that the material was too hard to permit driving the piles to the depth called for in the contract. The board, which consisted of Messrs. A. J. Menocal, P. C. Asserson and F. C. Prindle, reported that if the contractor would sharpen his piles more and drive them a longer time, he could sink them to the penetration called for in the contract.

San Antonio, Tex., with a population of 40,000, is just considering the construction of a sewerage system. Detailed plans and estimates for a separate system have

been made by Mr. Samuel M. Gray, M. Am. Soc. C. E., Providence, R. I. The estimated cost of a complete system is $989,000 and of a system which would serve for the present, $379,000. The first sum includes a pumping plant and disposal of sewage by irrigation. The second plan contemplates discharge of the sewage into the San Antonio River, but for $110,000 additional an outlet sewer, pumping plant and land for irrigation could be secured. Mr. A. C. Pancoast is city engineer and Mr. T. H. Mickiejohn is Superintendent of Public Works at San Antonio.

An artesian well with a daily flow of 4,200,000 gallons is reported as having been put down by the San Antonio Water-Works Co. Later reports may give a diminished flow.

The new union station at St. Louis is to be opened in September. It has been fully described and illustrated in our columns.

Pneumatic caissons are being used in constructing the foundations for the 20-story building to be erected by the American Surety Co. at the corner of Broadway and Pine St., New York, the arrangement being similar to those employed for the Manhattan Life Insurance Building, now nearly completed. The Surety building will have an area about 85 ft. square, and there are 13 caissons. In the handling of material considerable room has been gained by building a working platform at the street level over a part of the area excavated. On this carts loaded with material are driven in from the street, or others are loaded with the earth excavated, and underneath it are the air compressors and other parts of the operating machinery. This platform may be extended or removed from time to time to keep out of the way of the caissons as they are put down. These caissons are sunk continuously. Four or five are simultaneously progressing at different stages, and work is prosecuted continuously, electric light being used at night. Steam is taken from the steam company's mains.

A committee of the English House of Commons, appointed to inquire into the London Streets and Building bill, has decided that no building, except a church or chapel, should exceed 80 ft. in height.

The movement to restrict the thickness of car-wheel flanges, which was inaugurated at the last Master Car Builders' convention, is being carried forward. Secretary John W. Cloud has addressed a circular letter to all the car-wheel manufacturers in the United States requesting them to adopt and use the M. C. B. standard flange gage, which limits the thickness to 1 7-16 ins. The month and year of manufacture are to be cast on the inside plate, in letters 1¼ ins. high, of all cast iron wheels manufactured after Aug. 31.

A new triple-valve for air-brakes is being developed by Mr. J. H. Crosman, of Hoboken, N. J., which permits auxiliary reservoirs to be recharged while the brakes are applied, provides for quick release of the brakes and is claimed to excel all others in the rapidity with which full pressure is attained in the brake cylinder.

Australian timber for street-paving, says City Surveyor A. C. Mountain, of Melbourne, was first used in Sydney, New South Wales, in 1880. The result of the test was satisfactory, and Melbourne soon followed the example. At the present time these two cities have over 500,000 sq. yds. of street laid with Australian hard woods. As now laid the blocks have not more than ¼-in. joints; and lately the joint has been abandoned in Sydney and the blocks laid close together. In New South Wales the wood principally used is the tallow-wood (Eucalyptus microcorys), the black butt (E. pilularis), and the spotted gum (E. maculata). The various iron-barks, though strong and durable, are too valuable for street-paving. In Victoria the only local hard wood used is Murray River red gum (E. rostrata), but the West Australian kauri (E. diversicolor) has been introduced along with the New Zealand kauri pine. The latter, though not a hard wood, lasts longer on the streets than Baltic or Memel pines. The statistics as to wear are very variable, but Mr. Mountain says that a thoroughly well-made wood pavement will last in Melbourne from 12 to 14 years. This means the use of well-grown sound timber, free from sap, laid on a cement concrete foundation from 6 to 12 ins. thick, finished off with 1 in. of 3 sand to 1 cement. The blocks would vary in length from 7 to 9 ins., be 3 ins. thick and 6 ins. deep. These blocks are dipped in hot tar, well drained, laid with close joints diagonally across the street and the joints "run in" with hot tar, boiled two hours and no longer.

PERSONALS.

Mr. Geo. W. Bendre, an American mining engineer, was murdered recently in the mountains in the state of Guecreco, Mexico.

Mr. Geo. H. Crisley, General Manager of the Wis-

WEATHER TABLE FOR JUNE, 1894. (Furnished to Engineering News by the Department of Agriculture.)

	Stations.	Temperature. (Deg. Fahr.) Average.	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average.	Max.	Direction at time of max. velocity.	Precipitation—rain or melted snow—inches. Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	64.5	89	30	59	8.2	32	N	1.71	.57	12
	Portland, Me.	63.2	94	44	50	7.1	26	S	2.01	.65	10
	New York, N. Y.	70.6	94	48	46	8.6	29	NW	.86	.23	10
	Pittsburg, Pa.	71.6	95	42	53	5.1	33	NW	.61	.29	11
	Chicago, Ill.	71.4	93	40	53	14.8	50	SW	1.96	.63	9
	Omaha, Neb.	74.0	97	47	50	8.1	38	SW	4.74	1.07	12
	St. Paul, Minn.	72.2	93	41	52	7.1	34	SW	1.51	.53	8
	Duluth, Minn.	62.7	88	40	48	5.9	25	E	1.80	.65	9
	Bismarck, N. Dak.	68.2	96	37	59	10.3	39	NW	1.76	.55	9
	Average	68.7	93	41	52	8.4	34		1.88	.57	10
Southern Cities	Washington, D. C.	73.6	98	46	52	5.4	30	NE	1.24	.87	5
	Louisville, Ky.	76.9	96	46	50	6.1	30	S	3.63	1.34	9
	St. Louis, Mo.	78.4	99	44	55	9.2	44	NW	1.12	.54	6
	Savannah, Ga.	77.4	96	59	37	7.1	40	NW	2.97	.95	11
	Kansas City, Mo.	75.0	95	50	45	8.3	33	SW	8.16	2.91	13
	Jacksonville, Fla.	78.0	92	62	30	7.0	32	SE	4.93	1.40	12
	Chattanooga, Tenn.	75.7	96	45	51	6.0	30	W	1.77	1.06	6
	New Orleans, La.	78.2	97	63	34	5.7	28	S	5.19	1.17	14
	Memphis, Tenn.	78.4	98	51	47	5.9	34	SE	2.60	1.34	5
	Palestine, Tex.	77.6	96	53	43	6.0	20	N	4.03	1.48	10
	Average	76.9	96	52	44	6.7	32		3.56	1.32	9
Western Cities.	Helena, Mont.	59.0	88	39	49	8.0	35	SW	2.09	.78	9
	Port Angeles, Wash.	54.2	79	42	37	5.9	24	W	1.88	1.29	10
	San Francisco, Cal.	55.9	69	47	22	14.2	36	SW	.56	.22	5
	Salt Lake City, Utah	63.9	89	40	49	6.7	30	NW	1.38	.86	6
	Santa Fe, N. Mex.	64.0	86	43	43	9.0	38	SW	.77	.63	5
	Denver, Colo.	66.0	94	45	49	8.3	38	NW	.39	.22	7
	Yuma, Ariz.	79.4	108	55	53	7.2	34	W	.00	.00	0
	Average	63.2	88	44	43	8.5	34		1.01	.57	6

cassett & Quebec Ry., has resigned on account of ill-health and has been succeeded by Mr. R. T. Rundlett.

Mr. Simon Ingersoll, inventor of the Ingersoll rock drill, died at Green Brook, near Stamford, Conn., July 24, at the age of 84. He was born at Greenwich, Conn.

Mr. H. G. Clarke has been appointed General Superintendent of the Kansas City & Northwestern Ry. This is a branch of the Missouri Pacific Ry., and Mr. Clarke holds the same position with that road.

Mr. Samuel T. Wagner, M. Am. Soc. C. E., has been appointed Assistant Engineer, in charge of the Pennsylvania Ave. subway, Philadelphia, for which $6,000,000 were recently appropriated by council. He was appointed by Mr. J. H. Windrim, Director of the Department of Public Works.

Mr. Jas. T. Ford, Assoc. M. Inst. C.E., formerly with the Nicaragua Canal Co. and lately in the employ of the Jamaica Government Public Works Department, has been reappointed Chief Engineer of the Cartagena, Magdalena Railway, in the Republic of Colombia. Mr. Ford originally located this latter line as built, and is now sent back to complete the line and operate it.

M. Edmond Jean Baptiste Guillaume, a noted French architect, died in Paris, July 20. He was born at Valenciennes in 1826. He was sent on a scientific mission to Asia Minor by the government in 1861. He received many medals in recognition of his architectural work, the last one from the Paris Exposition of 1889. He was made a member of the Legion of Honor. Since 1884 he had been Professor of the Theory of Architecture in the Ecole des Beaux Arts.

Mr. Moses M. Strong, who died at Mineral Point, Wis., July 20, was born in Rutland, Vt., in 1810. He graduated from Dartmouth College in 1829, and studied law. In 1833 he was appointed Deputy Surveyor-General of Vermont, and in 1837, Governor Lyle, of Wisconsin, appointed him Surveyor of Government lands on the west side of the Mississippi River. In 1852 he devoted much of his time to the construction of the La Crosse & Milwaukee Ry.; subsequently he was an important factor in the construction of the line to Mineral Point. He served as president of the La Crosse Ry. until the financial panic of 1857. Mr. Strong spent six years in building and extending these two lines of road.

NEW PUBLICATIONS.

MINERAL RESOURCES OF THE UNITED STATES; 1893. By David T. Day, Chief of Division of Mining Statistics and Technology, U. S. Geological Survey, Washington, D. C. 8vo; pp. 810.

This is the tenth report, and its scope is similar to that of the preceding reports, but includes more references than usual to the condition of the mineral industries in foreign countries. The total value of the mineral products was the smallest since 1889. It represented $899,821,670, as compared with $688,616,954 in 1892, a decline of 11.44%, while in 1892 there was an increase of $30,500,000, or 4.67%, over 1891. The decline in value was most conspicuous in pig iron and structural materials, but most other minerals also declined in the amount and value of the product, the exceptions being gold, anthracite coal, aluminum, phosphate rock and gypsum. Bituminous coal showed a slight increase in quantity, but the normal increase was checked and the total value was less than in 1892. Petroleum increased in value but decreased in quantity. Salt, quicksilver and several smaller products increased in quantity, but showed the usual decline in value. This general decline is attributed to the financial depression and the consequent decreased demands.

HOW TO BUILD DYNAMO-ELECTRIC MACHINERY. Embracing the Theory of Designing and the Construction of Dynamos and Motors, with Appendices on Field Magnet and Armature Winding; Management of Dynamos and Motors, and Useful Tables of Wire Gages. By Edward Trevert. Lynn, Mass.: Bubier Pub. Co. 8vo, cloth; pp. 339; 178 illustrations; $2.50.

The number of amateurs who spend spare hours in constructing electrical machinery is much greater than is generally realized. The book before us is especially designed for this class of workers, and is therefore written in a non-technical manner, with only so much theory as is absolutely necessary. The author gives directions for building small motors and dynamos, both alternating and direct current, from mere toys up to 1 HP. A portion of the book is devoted to explanations of the structure of common makes of dynamos and motors.

TRADE PUBLICATIONS.

FREIGHT, MINE AND DUMP CARS. Bloomsburg Car Co., Bloomsburg, Pa. 8vo; pp. 55; illustrated.

This is a well arranged and well printed catalogue, showing a great variety of freight cars and small light cars of wood and iron for plantation use, mines and construction works, factories, etc. Dimensions, weight, etc., are given in each case. The "beamless" brake rigging, Bowden self-oiling car wheel journals, portable houses for contractors, and frogs and turntables for industrial railways are among the company's specialties.

ORE AND ROCK CRUSHING MACHINERY. Earle C. Bacon, New York. 8vo; pp. 34; illustrated.

This is a descriptive catalogue and price list of various crushing machines, including the Farrel (Blake pattern) crushers, Bacon's crushing rolls, coke crushers, mortar mills, etc. Also sizing screens and different arrangements of complete crushing and screening plants.

AUTOMATIC ENGINES. Weston Engine Co., Painted Post, N. Y. 8vo; pp. 35; illustrated.

This is a pamphlet on the Weston automatic engine for high and medium speeds, with descriptions and cuts of the several parts.

COMING TECHNICAL MEETINGS.

WESTERN SOCIETY OF ENGINEERS.
Aug. 1. Secy., Thos. Appleton, Lakeside Bldg., Chicago.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Aug. 3. Secy., O. Von Geldern, 719 Market St., San Francisco.
ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
Aug. 9. Secy., G. W. Shaw, Norton Building.
NORTHWEST RAILWAY CLUB.
Aug. 14. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
Aug. 14. Secy., D. W. McMorris, Burke Blk., Seattle, Wash.
AMERICAN ASSOC. FOR THE ADVANCEMENT OF SCIENCE.
Aug. 16 to 23. Brooklyn, N. Y. Secy., W. Putnam, Boston.
AMERICAN FORESTRY ASSOCIATION.
Aug. 20 to 24. Brooklyn, N. Y. Secy., J. D. W. French Boston, Mass.
SOCIETY PROMOTION OF ENGINEERING EDUCATION.
Aug. 20 to 23. Brooklyn, N. Y. Secy., Prof. J. B. Johnson, St. Louis, Mo.
ROADMASTERS' ASSOCIATION OF AMERICA.
Sept. 12. New York. Secy., W. W. Sharpe, Waycross, Ga.
ASS'C. SUPERINTENDENTS OF BRIDGES & BUILDINGS.
October. Kansas City, Mo. Secy., S. F. Patterson, Concord, N. H.
AMERICAN SOCIETY OF RAILWAY SUPERINTENDENTS.
Oct. 20. New York. Secy., G. A. Hammond, Boston.

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F. P. BURT.....ASSISTANT MANAGER

CHICAGO OFFICE: 1,636 The Monadnock.
CHAS. S. HILL.....RESIDENT EDITOR.
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ADVERTISING RATES: 20 cents per line agate measure. Want notices, special rates, see page 22. Rates for standing advertisements sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.

Very little has ever been published in the technical press or even in the newspapers concerning the great enterprises of land drainage which are being carried out in the state of Florida. For a number of years we have been endeavoring to obtain a substantially complete account of land reclamation enterprises that are under way in that state; and we are able to present in this issue a paper by Mr. J. Francis Le Baron, M. Am. Soc. C. E., describing these land drainage works.

It may be well to explain why land drainage in Florida promises in some respects better returns than the drainage of similar tracts in more northern states. It appears, in the first place, that the land in these Florida swamps when once freed of water is of remarkable fertility, and is especially adapted for sugar cane, yielding crops far in excess of the Louisiana plantations and equal to the best yields of Cuban or Sandwich Island lands. Mr. Le Baron states that a yield of 30 tons of sugar per acre has been made on lands drained by the Disston Co., which seems well-nigh impossible, and doubtless represents the maximum ever attained. But even taking an average yield amounting to only a small fraction of this, and it is seen that the lands are far more valuable than lands devoted to any other crop. We believe the Disston company itself estimates the probable value of its best lands when well drained at $600 per acre; and remembering that in its present condition the land is absolutely worthless, the wonder is that the work of land reclamation in the state has progressed so slowly.

An extraordinarily high insurance rate has been fixed by the Brooklyn Board of Underwriters on the car house of the Brooklyn City R. R. Co. The structure is located at Third Ave. and 58th St. and covers a block 700 × 200 ft. Cars are stored on three floors. The rate fixed for insurance on the building was 6%, and on the contents 5.55%. In view of the many serious losses in such stations, however, during the past two years, it can hardly be claimed that this rate is excessive. While electric railway companies persist in storing their cars in flimsy wooden fire traps, they must expect to pay dearly for insurance. Their only relief will be found by building their car houses of incombustible materials, and equipping them with automatic sprinkler systems. The electric railway companies, in fact, are in a very similar position to that in which the New England cotton manufacturers were prior to the organization of the Manufacturers' Mutual Insurance Companies. They must follow a similar policy of adopting and adhering to modern methods of protection against fire, if they do not wish to see their earnings swallowed up in insurance bills.

The wonderful results which have followed the introduction of automatic sprinklers are little realized outside of the textile industry. Were they generally understood, we should see this system of fire prevention applied in tens of thousands of manufactories and warehouses whose owners are now paying enormous insurance rates, and living in constant fear of losses which insurance will be insufficient to cover. The Boston Manufacturers' Mutual Insurance Co. has just issued a special circular with the pertinent title, "Automatic Sprinklers Everywhere? When?" In this circular President Edward Atkinson shows that the automatic sprinklers and other safeguards which have been introduced through the agency of the Manufacturers' Mutual Insurance Companies have saved the members about $12,000,000 in reduced losses and lowered insurance rates, whereas the total investment in sprinklers, etc., has not been over $4,000,000. The actual cost of insurance to all members of the Boston Manufacturers' Mutual Fire Insurance Co. for the period 1890 to 1894 has averaged only 20 cts. per annum per $100 insured, or 0.2%. Of this total expense 16.96 cts. is due to actual losses by fire; and Mr. Atkinson estimates from the percentage of losses which have occurred where automatic sprinklers had not been brought to their present standard that the rate of loss can yet be further reduced to an average of 10 cts. per annum per $100 insured.

Perhaps there is no branch of engineering in which there is more room for good work to be done than in what may be called fire-protection and fire-prevention engineering. At present a singular apathy seems to exist in the public mind on this point. People go on paying enormous insurance rates year after year, and bow resignedly to the loss of property and the annihilation of business when conflagration finally comes, as if it were a calamity inflicted by a supernatural agency. Eventually this will pass away and it will come to be understood that the old adage, prevention is better than cure, is as true of the ravages of fire as of those of disease. If the owner is not himself an expert, it is as proper for him to employ an engineer to plan his building with reference to fire prevention and protection as to employ a sanitary engineer to plan its equipment for the protection of health.

The friends of irrigation are using the industrial depression, which has now prevailed for a year or more, as an argument for the development of arid land by the application of water as a means of providing work and homes for a portion of the unemployed. It is urged that in the past the unoccupied public lands have served as a safety valve to unemployed or poorly paid labor, but that now all the public land available for cultivation has been taken up, leaving only the arid lands. Irrigation, it is urged, might be used to throw open for settlement immense additional areas of public land now wholly, or almost wholly, unproductive, which would stimulate all other branches of industry. To add to the force, and especially to the interest, of the arguments, frequent reference is being made to a letter written years ago by Macaulay to an American friend, in which the historian said that with the exhaustion of our unoccupied lands and the congestion of manufacturing centers, our institutions would be "fairly brought to the test."

The advertisements of various land and water companies located in the arid regions show an apparent plenty of good watered land awaiting the settler, but this land, justly enough, is held at a much higher price than were even the most fertile of the public lands, and much of it is sold subject to a yearly water rental, which is often more or less galling to the settlers. Large numbers of people in the Western states are, therefore, demanding that the vast tracts of arid public lands about them be watered by great irrigation works, carried out by the issue of national or state bonds, bearing low rates of interest, and that the land thus watered be sold in small holdings to actual settlers at cost, a right to sufficient water for cultivation being made inseparable from the land. Under this plan such of the public lands as are not already held by the states and territories must either be ceded to them by the national government for improvement or the latter must carry on the work itself.

The questions presented above will be discussed in all their bearings at the Third National Irrigation Congress, to be held in Denver the week beginning Sept. 3. At this meeting commissions from 17 states and territories are expected to report their opinions and the results of their investigations on these and allied subjects, and irrigation in all its aspects, will be discussed.

Denver is an excellent place for the convention on account of its central location, both as to territory and irrigation interests. The first irrigation congress was held at Salt Lake City in 1892, and the second in Los Angeles last fall. Mr. Wm. E. Smythe, editor of the "Irrigation Age," of Chicago, is chairman, and Fred L. Alles, of Los Angeles, Cal., is secretary of the National Executive Committee.

THE DISPOSAL OF GARBAGE AND OTHER CITY REFUSE.

Among the new demands upon engineers within the past few years are those involved in the sanitary and economical disposal of garbage and such other city refuse as cannot be conveyed through sewers. This refuse includes not only the wastes of cooking and the table, commonly known as household garbage, but also ashes, tin cans, bottles, stable manure, street sweepings and dead animals. It is obvious that some of these materials, if kept by themselves, can be disposed of without great difficulty, and even to advantage, without the exercise of any special skill. Thus, ashes may be used for filling; cans and bottles may have more or less commercial value; stable manure may be utilized as a fertilizer; and street sweepings may be used sometimes as a fertilizer and sometimes for filling, according to their character. Mix these wastes together and their disposal is not so easy, while if garbage is indiscriminately added a thoroughly sanitary disposition of the mixture is almost impracticable.

The value of stable manure is such that it is generally disposed of without further care on the part of the sanitary authorities than to supervise its storage and handling. Cans and bottles, when not got rid of separately, generally make trouble by increasing the bulk of the refuse to be handled. All dead animals are troublesome and should receive separate treatment, although they may be disposed of by any, or most, of the garbage destructors, and are often taken to rendering establishments, which need not be considered here. The bulk of the refuse to be cared for, it is seen, is garbage, ashes and street sweepings.

The fundamental principle of the sanitary disposal of city refuse is that garbage should receive a separate treatment, owing to its offensive putrefactive character. This latter renders accumulations of untreated garbage near habitations intolerable and prohibits its use for filling in future building lots, since complete decomposition may be delayed for years.

Where satisfactory disposal can be had by dumping in deep water, garbage, ashes and street sweepings may be indiscriminately mixed, provided the ashes and sweepings cannot be put to some profitable use. Probably if the garbage was out of the way there would be far less dumping at sea or in other waters than is now practiced.

Sanitation and economy, therefore, point towards a separate treatment of garbage. Unfortunately, it is difficult to secure the separation of garbage and ashes, owing to the carelessness and indifference of both servants and householders and the objection to having two receptacles about where one would hold the accumulations of both kinds. The more crowded the population the more objectionable is the doubling of receptacles, although this might perhaps be overcome in some manner if the cooperation of all concerned could be secured. With

both health and dollars involved determined sanitary authorities should be able to lay down and enforce such rules as would result in the separation of ashes and garbage. Even partial success will be a gain. Here as elsewhere a vast amount of educational work remains to be done and much depends upon the pluck and energy of the sanitary officers and the backing which they receive from the other branches of municipal government and the press. Some of the state legislatures have given local boards of health ample powers for the prevention of nuisances and these powers are already being used with good results in this very connection.

Passing from the more purely administrative side of the question to the engineering problems involved in the final disposal of garbage we find four general methods in vogue which are worthy of examination. First, however, it should be said that with human nature as at present constituted and with the present popular ideas regarding nuisances and sanitation in general, whatever method a city may adopt will meet with bitter opposition from a few and quite likely will be condemned by many. And this opposition and condemnation will very probably come from those whose premises are in a deplorable sanitary condition. All this must be disregarded so far as possible and comfort be taken in the belief that the best possible methods are in use.

The four general methods of garbage disposal worthy of consideration heretofore practiced are: (1) Burial in the earth so that oxidation will be carried on and the garbage eventually destroyed. Obviously this is practicable only for small populations. (2) Dumping at sea or in other waters where objectionable filling in will not result and where the garbage will not float about or be washed ashore. This method also has its limitations, through lack of available dumping waters. (3) Cremation, where destruction is the principle object. (4) Utilization by means of some form of chemical or other treatment, either with or without subsequent cremation, the attempt being to secure some commercial product or products.

The limitations of the first two methods have been mentioned. In sea dumping, it may be added, the garbage scows are likely to be a nuisance while being loaded and while being towed through the harbor. In stormy weather, and on other occasions when opportunity affords, the dump is often made far inside the dumping grounds, which of course is liable to cause nuisances. But this is a matter of proper inspection and should always be prevented by efficient officers.

In both cremation and utilization mechanical problems arise which it is the province of the engineer to solve. In cremation the two main objects are (1) complete combustion, including that of all offensive gases incident to the process, and (2) this to be effected with as little fuel as possible. The ideal furnace would require no fuel save for kindling and would consume all the offensive gases. It might even go further and furnish the small amount of power needed in some cases for handling the garbage or for other purposes about the plant.

In the utilization processes the inoffensive production of the greatest possible amount of commercial matter at the lowest possible cost is the object to be obtained. Grease and fertilizing material are the commercial products secured. To extract the grease chemicals must be used and to prepare the fertilizer moisture must be removed and the material pulverized or otherwise broken. The aim is to recover the chemicals for repeated use and to consume as little fuel as possible for drying or for power used in pressing, grinding or otherwise. The danger of this process is that commercial products may be placed before sanitary results and discredit brought upon the attempt to solve the garbage disposal problem. The great advantage claimed for the utilization process is that the commercial products partially pay for the cost of treatment. But where small amounts of garbage are to be handled cremation would probably be preferable to utilization.

A proposed method of treating garbage so that it may be used for filling without nuisance in connection with ashes and street sweepings is now in temporary use by the street cleaning department of New York city and bids for a permanent plant will be opened July 26. The plan outlined in Engineering News for Oct. 27, 1892, of filling around Riker's Island, in the East River, was put in operation in December of last year but gave rise to such complaints that attempts are now being made to disinfect the material already accumulated while further dumping has been stopped for the present. The disinfectant employed has been sodium hypochlorite under the trade name of electrozone, the use of which for treating the sewage of Brewster, in the Croton watershed, for treating a part of the Croton water supply and for disinfecting the slip at the foot of Canal St., in this city, was described in our issues of July 13, Aug. 10 and 31, 1893. The solution has been sprayed on top of the garbage and refuse by means of hose and is relied upon permanently to deodorize the material as far as it penetrates. The solution is manufactured by the partial decomposition of sea water by electrolysis and it is claimed for it that if properly applied to the refuse as dumped no offense will arise and that the cost will be much less than the cremation of the garbage contained in the mass. We will not venture to express an opinion as to the efficiency and cost of the process. Thus far this method of disinfection and of water and sewage treatment has not been employed by any other municipality than the city of New York, although Danbury, Conn., proposes to treat sewage by it. It is as yet on trial, and so far as we can ascertain there are no official records of tests of its cost and efficiency which would warrant its adoption by an engineer, but the same may be said of many other new processes in their early development.

LETTERS TO THE EDITOR.

PEW'S FORMULA FOR COMPUTING EARTHWORK.

Sir: Referring to the article on p. 160 of your issue of Feb 22 by Prof. M. D. Taylor on "A New Formula for Computing Earthwork Cross-Sections," again referred to by you on p. 430 of your issue of May 24, allow me to say: First, while Mr. Arthur Pew doubtless discovered the formulas referred to, they are nevertheless very old. In 1868 Mr. C. S. Woodard, Chief Engineer of the Jackson, Fort Wayne & Cincinnati R. R. (still living in Ypsilanti, Mich., I think), handed the writer tables in manuscript giving in one column the area corresponding to the mean height,

$$M = \frac{h + 2c + h'}{4},$$

and in another the correction $r\,(M - c)^2$. Mr. Woodard told me that he obtained the tables some years before that time from an engineer on the Michigan Central R. R., I think, of the name of Neill or MacNeill. Perhaps they date back to Sir John MacNeill, or still further back.

Secondly, I used the formulas and tables no longer than necessary, and soon computed others much better, because much shorter and involving much less labor. These I have used while in charge of several railways and other works, including 14 years as professor of civil engineering in the State University of Iowa; and my assistants have also used them. To these men and to others I can refer. I expect to publish them soon.

Making, for purposes of comparison, no distinction between additions and subtractions, or between multiplications and divisions, the formulas in question require three multiplications, while my formula requires but one to produce the same result. The additions are in about the same ratio and are omitted. Moreover, comparing the tables, those in question require, for a given cross-section two readings with considerable preparation, while my tables require but one reading and almost no preparation. Where total quantities alone are required the difference is still greater. Having had experience with both I risk nothing in saying that with my tables results can be found several times over before they can be found once with those under consideration. Yours very truly, P. H. Philbrick.

Lake Charles, La., June 9, 1894.

(We referred the above letter to Mr. Woodard, who replied as follows:—Ed.)

Sir: In answer to your question as to the origin of the method of computing earth work as per Prof. P. H. Philbrick's communication: In 1851, while acting division engineer on construction of a portion of the Michigan Central R. R., I used tables of excavation and embankment, calculated, it was said, especially for the Michigan Central R. R. work by a prominent German engineer by the name of Hans Thielson, at that time acting first assistant to Col. J. M. Berrien, then and for a long time before and after Chief Engineer.

After the completion of the Michigan Central R. R. I think Mr. Thielson was for a time connected with the Chicago, Burlington & Quincy R. R. Subsequently, he was called to the position of Chief Engineer of the Oregon Transportation Co., and constructed their railway from Wallula Junction down the Columbia River to Portland.

Colonel Berrien at the time (1851) had the only copy, in manuscript, of the tables that I knew of, and he kindly allowed me to copy them, which copy I now have. They were never published to my knowledge. When, some years ago, the Michigan Central depot and offices at Detroit were burned. Colonel Berrien's copy was lost, and I sent mine in for him or his assistant to copy.

I used these tables for several years on construction of various roads, and as Mr. Philbrick was, in 1868, an assistant of mine, on the Fort Wayne, Jackson & Saginaw R. R., he, with several other assistants, had copies of these tables and I have no doubt he made use of them as he states. That the method originated with Mr. Thielson I never had a doubt, and probably several years before I was with him on the Michigan Central R. A. A few years ago, Mr. Thielson made me a short visit, and in the course of our conversation I asked him concerning the origin of the method. He being a modest and unassuming gentleman, laid no claim to originality, but said a short and easy method was needed and it was gotten up and used on the construction of the Michigan Central R. R. He said, however, that some one, he had forgotten the name, had written him to know if he had any objection to the tables being published, and he replied that he had not. To my certain knowledge the tables have been in use for more than 40 years, and I think I may safely say more than 50.

Very respectfully,
C. S. Woodard.

Ypsilanti, Mich., June 26, 1894.

(Proofs of the above letters were then furnished to Mr. Pew, and we append his reply, as follows:—Ed.)

Sir: In the formula given by Professor Philbrick I presume that h and h' refer to the side heights, and c, to the center height of a cross-section. If so, it is the same formula that I recommended for reducing sloping sections to level ones, and claimed to be original. The table he refers to seems to have been nothing more or less than a table of end areas for level cuttings, with a column giving correction to be subtracted for given values of $(M - c)$.

From his brief description, I infer that the method he used was to reduce all sections to level cuttings, take the end area from one column of the table, subtract the correction, and then proceed to calculate the cubic contents of the prismoid by the end areas found. If this inference is correct, a very simple and common device for economizing labor (that is, using tables of cubic yards instead of end areas), was neglected, and the system had nothing in common with the one recommended by me, except the method of reducing sloping sections to level ones. I do not use the table of correction for transverse slope, except on ground of unusual character, for while the method gives a result slightly in excess of the mathematically true contents of the prismoid, the amount is so small that it rarely exceeds an allowance that should be made for the slightly curved surface which the earth presents both to excavations and embankments.

The formula was discovered by me without any suggestion from any one, so I naturally supposed that I was the first one to discover it. It was not found out by any happy inspiration, but was simply the result of evolution. Commencing on my first Residency with the prismoidal formula, I made gradual changes in its application and the next year reduced all sections to level cuttings by the method under discussion, and calculated their contents simply by adding together the cubic yards, taken from two tables, designated as A and B. Table A was the ordinary table of level cuttings. Table B was a correction for longitudinal slope.

I commenced using this method in 1880, and have been using a modified form of it ever since, but did not discover the formulas until 1883. I had previously calculated table B, but it was in a very slow and awkward manner. In 1883, having had some heavy work in Mexico, I commenced trying to work out the formulas, and found that the area of a level section whose height is one-fourth of the sum of the side heights and twice the center height, always exceeds the area of the original section by $d\,r^2$ where d = the difference between the new height and the original center height and r = the side slope ratio.

I also found that the formula for correction for longitudinal slope was $\frac{d^2\,r}{3}\,L$ where d = the difference between either end height and the middle height of the prismoid, and L = its length. Having worked out these formulas without any assistance or suggestion from any one, I believed that both of them were original, and was preparing to publish them some years ago, but was discouraged on finding that practically the same formula for correction for longitudinal slope, was published in Mr. A. M. Wellington's work on "Computation of Earthwork from Diagrams."

I have searched diligently for any indication that any one had preceded me in working out the other formula, and recently sent it to the professors of engineering and mathematics in every college of engineering in the United States, offering a small prize to the student who would send me the best general, geometric demonstration of it.

I have also explained it, during the past ten years, to numerous engineers, but Professor Philbrick's letter is the first intimation I have had that any one else had any previous knowledge of it. I did not desire any special credit for this formula, but I was desirous that I should not be charged with appropriating and publishing another man's idea.

I think, however, that when an engineer discovers a useful formula, and it is kept in manuscript among a few friends for 40 or 50 years, it is time for some one else to discover it and give it to the public.

Having never done any work north of Kansas City, and not being a mind reader, I can hardly be expected to know what formulas or tables an engineer in Michigan or Oregon, has in his private notebook. Neither can I compare a book Professor Philbrick proposes to write with a book that I expect to write.

I have no objection to his praising his own work, but as I propose to publish my method soon, under the title of "Railroad Prismoids," if he will reserve his criticisms until he reads it, they will come nearer "checking" with the book. He has invested my system with so many multiplications, additions and subtractions that, if it is mine, I fail to recognize it.

Without attempting to discuss its merits in the Correspondents' column of the News, I will simply say that in my opinion, it is an excellent method, and 16 years' practice in the field inspires me with some confidence in my own judgment.

The fact that Colonel Berrien, after having used the formula since 1851, should send to Mr. Woodard for a copy of the tables, when his own copy had been destroyed some years ago, is a strong recommendation of the method, even without the improvements which I believe I have made in it. I think if Professor Philbrick had really understood my method he would not have made the extravagant statement with which he closes. Yours truly, Arthur Pew.

Macon, Ga., July 12, 1894.

A TWELVE-MILE TRANSMISSION OF POWER BY ELECTRICITY.*

A number of papers on the use of electricity in mining operations have been presented at the Institute meetings recently, but only a very few of them have given particulars and details of the application of this power. It is therefore believed that a description of one of the most extended transmissions of power by electricity in operation to-day may be of interest.

At Bodie, Cal., the ruling price for wood has been, for years past, $10 per cord, so that the monthly fuel bills of a 20-stamp mill, crushing and amalgamating 50 tons of ore per day, would often amount to $2,000. To reduce this excessive cost of motive power was the problem in hand, and the use of electricity generated by water-power has solved it. No sufficient water-power could be found nearer than 12 1-2 miles, the distance from Bodie in a straight line over the hills to the east flank of the Sierra Nevada.

There has recently been installed near Genoa, Italy, a continuous-current plant, transmitting 300 HP. a distance of 18 miles to that place. At the power stations (of which there are three, one below the other) there are four groups of dynamos, each group of two dynamos driven by turbines (Piccard system) of 140 HP., under heads varying from 738 to 1,623 feet. These are connected in series, one group being held in reserve, and produce each a current of 47 amperes and 1,000 volts, the resulting electro-motive force sometimes reaching 6,000 volts during the hours of maximum load. The motors are also connected in series, no one machine, it will be noted, carrying a potential exceeding 1,000 volts at any time. This necessary "series" arrangement of dynamos and motors forms the great drawback to the use of the continuous current for long-distance transmission, more especially where the range of work to be performed is wide and varied.

Nearly three years ago the Westinghouse Electric & Mfg. Co. installed a 120 K-W. generator for the San Miguel Consolidated Mining Co. at Telluride, Colo., and transmitted 150 HP. a distance of three miles by the single-phase alternating current synchronous system, successfully operating the 40-stamp mill of the Gold King mine, the generator being driven by Pelton water-wheels and working under a potential of 3,000 volts. During the past year this plant has been increased by the addition of an 800-HP. generator, from which current is transmitted eight miles to a 250-HP. motor, driving a 120-stamp mill of the same company. The excess of power is to be utilized in operating other stamp mills in the vicinity.

After consultation with Mr. W. F. C. Hasson, electrical engineer, of San Francisco, it was decided to adopt this single-phase synchronous system as the cheapest in copper and the simplest for the work required, and the contract for electrical apparatus was let to the Westinghouse Electric & Mfg. Co. At that time neither the three-phase system (requiring three wires), nor the Tesla two-phase (requiring four wires) had reached their present state of development in this country. In the Niagara Falls transmission the above company is to use this two-phase system, which is undoubtedly better adapted to a variety of work than the single-phase, since the motors are self-starting.

An interesting installation of a three-phase plant has recently been made by the General Electric Co. at Redlands, Cal.; though the distance of transmission is but five miles. There are two alternators of 250 K-W. each, driven by four 30-in. Pelton water-wheels at a speed of 600 revs., double nozzles to each wheel. The differential governor, described later on in this paper, is used. The generators carry a potential of 2,450 volts and the motor about 2,150, the line-loss being approximately 12%. There are three No. 0, bare copper wires (insulated within the city limits) carried on deep-groove, double-petticoat glass insulators. This size of wire permits a subsequent enlargement of the plant. The line-poles are 35 ft. long, 6 ft. in the ground, and set 110 ft. apart. The one motor at present in operation, is a synchronous high-potential machine, of 150 HP., and has continuous work to perform in driving the ice machines of the Union Ice Co. The initial current in the fields of the motor is generated by a small exciter, and the motor is self-starting only under light load, the full load being thrown on after the machine is up to speed. The operation of this plant is stated by the manager, Mr. H. H. Sinclair, to be extremely satisfactory in every respect.

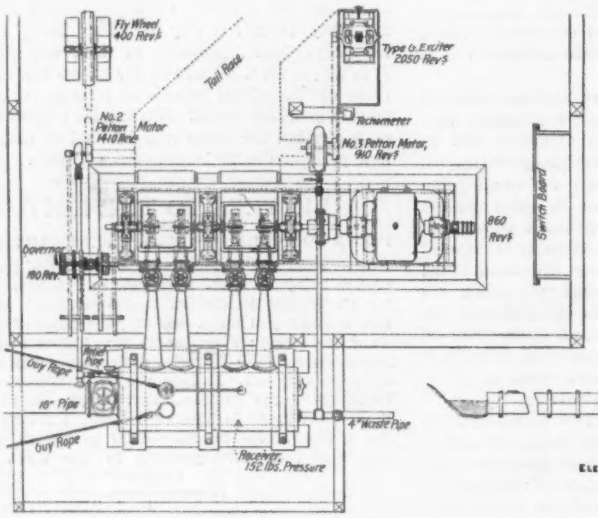


Fig. 2. General Plan of Power House.

Fig. 1. Plan and Elevation of Penstock and Flume at Power House.

At Bodie, the distance of transmission (12½ miles) is just at that intermediate point where the cost of transformers about equals the difference in cost between a No. 1 and a No. 6 copper wire (it is not advisable to use any lighter wire than No. 6, on account of its liability to rupture during storms). Hence it was deemed better not to use converters, since they would only complicate the apparatus, without effecting a saving in cost. This conclusion seemed perfectly correct at the time; but experience with the plant in operation tends to favor the use of potentials not exceeding 2,000 volts in machines of such small capacity.

Water-Power Plant.—An excellent water-power was found in a mountain stream on the north slope of Castle Peak in the Sierra Nevada. This stream carries 400 ins. of water during the dry season, and ten times that amount during the time of melting snows. An old ditch was cleared out and rebuilt for a length of 4,570 ft. and a site was selected for a power house, 355 ft. vertically below its lower end. The ditch was made larger than necessary for power purposes alone, with the object of supplying other parties, when there was an excess of water. Fig. 1 shows the connecting flume, pressure-tank and waste-weirs. The arrangement of the screen adopted, while it occasions a loss of head of a couple of feet, is greatly to be recommended where "anchor" and slush-ice form in a ditch during cold weather.

The pipe is of large diameter, in order to permit subsequent enlargement of the plant, and also to reduce loss of head by friction. It is fitted with three 2½-in. air valves, to prevent collapse in case of sudden rupture, and is anchored at proper intervals with straps of 1¼-in. round iron. The slip joints extend to a vertical head of 220 ft., the remainder of the pipe being laid with collar-and-sleeve lead joints. The pipe leads into a receiver, 40 ins. diameter and 9½ ft. long, from which four taper pipes lead the water on, under pressure of 152 lbs. per sq. in., to as many 21-in. Pelton water-wheels, each wheel being fitted with two nozzles, and rated at 60 HP. under the largest-sized tips of 1¼ in. diameter. The speed of the wheels is 860 to 870 revolutions, and their shafts are connected by an insulated rigid coupling to the armature shaft of a 120 K-W. alternator. Fig. 3 shows the generator and water-wheel in operation.

Power House.—The accompanying plan, Fig. 2, shows the arrangement of the plant, one of the most interesting features of which is the water-wheel governor formerly known as the "Doolittle," and now called the Pelton differential governor. It operates butterfly valves placed in the 5-in. pipes between the gate valves and the diverging nozzles; and though this form of valve invariably "throttles" the water to a greater or less extent (according to the position of the valve), it is a most satisfactory way of controlling the power where the same is ample, and the loss due to this cause is of slight consequence.

In starting up from rest, the governor is detached and the valves are operated by the hand lever. After the wheels are at normal speed and the load is on, the governor takes care of any and all variations, even to a complete throwing off of the load by pulling the main current plug switch at Bodie. The speed of the governor pulleys, as first designed, was 60 revolutions. This was found to be too slow and it was increased to 180 revolutions with most beneficial effects, developing a greater sensitiveness to small changes of load, and much quicker action, especially when all the load was thrown off at once. In the latter case the increase in speed of the water-wheels did not at any time exceed 12% before the governor began to close the valves.

The great drawback to the use of water-power for the generation of electricity has hitherto been the lack of a good water-governor, sufficiently sensitive and quick-acting to insure the vital factor of constant speed without bringing dangerous strain on the water-pipe. In fact, in the Westinghouse plant at Telluride, and in several others of which the writer is aware, a man sat with his hand on the lever of a deflecting nozzle and his eye fixed on a voltmeter or a tachometer.

The generator is a Westinghouse 120 K-W. constant-potential 12-pole machine, and its armature shaft is attached to that of the water wheels by a rigid coupling, insulated by a disk of oak, one inch thick and

* Abstract of a paper by Thomas H. Leggett, Bodie, Cal., presented at the Virginia Beach meeting of the American Institute of Mining Engineers.

soaked in oil, while the bolts are surrounded by bushings and washers of insulating fiber.

The initial current in the lower half of each field coil, or the winding nearest the armature, is instilled by means of a direct current exciter. The secondary winding on the armature spokes of the dynamo generates current when the machine is under load, which is led to a 12-bar commutator on the armature shaft and thence to the compensating winding which occupies the upper half of each field bobbin.

As the load on the generator increases, more current flows through its armature coils and through a primary winding on the armature-spokes, thereby inducing in the secondary winding a heavier current, which, being led to the magnetic field as described, proportionately strengthens the same. When the generator is running without load, there being little or no current in its armature-coils, none is induced in the secondary winding, and the compensating winding on the fields is without magnetic effect until the latter is required by work to be performed.

The potential of the generator under full load is 3,530 volts, but at present it is operating with about 3,390. The exciter carries a voltage of 105 to 112. A direct current voltmeter, recently placed on the switchboard to the left of the ground detector and above the small rheostat, is in the main circuit of the exciter, recording the tension of its current and serving as a speed indicator when the machine is driven by the No. 3 motor. This is not necessary when driving from the wheel shaft, as is sometimes done in winter, when pieces of ice give trouble in the small nozzle of the motor.

The generator current is led from the collector rings on the extreme end of the armature shaft to the plug sockets on the switchboard; and when the line plugs are in these, the current follows the line to two similar sockets on the motor switchboard. The small converter in the upper middle of the switchboard has a transforming ratio of 30 to 1. Its primary coil is attached to the main current wires from the generator, and its secondary to the A. C. voltmeter, immediately below it. A potential of 113 volts on the voltmeter is, therefore, equivalent to 3,390 volts on the dynamo current, which is the tension under normal load. The voltmeter does not, however, read 113 volts, but records 100 to 102 volts, the difference being due to the compensator (the instrument showing in the upper left-hand corner of the switchboard and connected with the voltmeter), the object being to reduce the reading by an amount about equal to the line loss. This loss is estimated at 15% under maximum load, and is but from 8 to 10% under normal load.

The ground detector with two lamps, one for each leg of the line, and each lamp with its converter behind it, has not as yet shown itself to be of any great usefulness, since the static effect of the line is sufficient to burn the lights with a dull red glare on making the ground connection with the press button, while any more serious ground on the line than one sufficient to give such a red light on the filaments would, in all probability, make itself felt quickly enough in the machines, without necessitating recourse to the detector to discover it.

When starting up the plant, one attendant stands at the lever, controlling the admission of water to the wheels through the butterfly valves and the other at the switchboard, handling the two rheostats (most of the regulation is done by the large one), until the motor is in synchronism and at work, when the governor is thrown into gear, the voltage is finally adjusted, and the mechanism is then practically self-regulating for all ordinary changes of load. If, for instance, 10 of the 20 stamps are to be hung up, or any or all of the eight continuous pans in the mill are to be stopped, it is never necessary first to give word to the attendant at the power house. The governor takes charge of such changes, even to the entire throwing off of the load, as before remarked. All the bearings of the generator and water-wheel shafts and of the exciter are self-oiling. The attendant has merely to keep on the "qui vive" and see that all is running smoothly. Any change in tone of the hum of the dynamo warns him at once of a change of conditions, the tone rising or falling according as the speed increases or diminishes, though ever so slightly.

To insure the all-important factor of constant speed, a tachometer, registering to 1,200 revolutions, is belted to the water-wheel and dynamo shaft. Its dial faces the water-wheels, so that the attendant at the valve lever can readily maintain a uniform speed during the operation of "synchronizing" the motor and starting the mill, at which time the load is constantly varying.

Two cords attached to the handle of the large rheostat are led around the side of the building to the attendant's place at the valve lever. A pull on these cords opens the exciter main and shunt-circuit instantly, and puts in the entire resistance box, thereby "killing" the fields of the generator and preventing any dangerous rise in electro-motive force, should the load be suddenly thrown off by a break in the wire line, or other accident causing a sudden increase in the speed of the armature shaft. It should be explained that this arrangement was devised by the writer, before the speed of the governor was trebled, the constant resistance flywheel was put in and other changes were made, giving more sensitive and perfect control of the water-power; and it is left in place because it might still be of use in case of emergency. The power house is lit by a small 10-light converter attached to generator circuit.

Wire Line.—The length of the line is 67,760 ft., or 12.46 miles. The poles are of round tamarack timber, 21 ft. long, 6 ins. in diameter at the top, set 4 ft. in the ground: poles 25 ft. long being used through the town, and along the line wherever there is danger of deep snowdrifts. They are placed 100 ft. apart, and fitted each with a cross-arm, 4 × 6 ins., boxed into the pole, and held by one bolt and one lag screw. The line crosses extremely rough country, not 500 yds. of which are level beyond the town limits. Most of the ground is very rocky. Over 500 lbs. of dynamite was used in blasting the pole holes.

The wire is of No. 1 (B. & S.) gage, soft-drawn, bare copper, and is attached to standard double-petticoat deep-groove glass insulators, carried on Klein patent iron pins. The distance between the wires is 3 ft. 8 ins., and there are over 16.5 tons of copper in the line. The only objection found to the iron pins is their liability to be withdrawn from the cross-arm during a gale of wind, wherever there is an upward pull on the wire. To obviate this, a number of pins were drilled with a ⅛-in hole near the end, and in all such places these were used, and held firm by driving a wire nail through them.

The wire was first attached to the insulators by tie wires of No. 10 galvanized iron wire. Later it was found advisable to insulate the line wire at the insulators, and for this purpose ordinary sheet rubber ⅛-in. thick, such as is used for gaskets, was cut into strips 1.5 ins. wide and 12 ins. long. These were wound spirally about the wire and held in place by two close wrappings of Manson's tape. The whole was then well daubed with asphalt paint, and the insulated wire reattached to the insulators by tie-wires of No. 6 weather-proof copper wire.

The line crosses a number of very steep ridges (from 300 to 800 ft. in height) and on these the wire necessarily pulls heavily on the top pole, and especially on its pins and insulators. In all such places the ordinary double-petticoat insulators were replaced by the large "Pomona" insulator on which the wire is carried in a groove across the top, and its weight is therefore directly down upon, and in line with the center of, the pin.

The line has given no trouble, and has carried the high potential of 3,000 volts without a leak, even during a severe storm of ten hours' duration, the rain changing to sleet and ice toward the end; but this severe test, it must be admitted, occurred after the wire had been wrapped at the insulators as described. In fact, one of the chief objects of this insulation was to render the line proof against just such a storm as this. Snowstorms have no effect whatever.

Motor Room.—The motor that drives the stamp mill of the Standard Consolidated Mining Co. at Bodie, is an A. C. synchronous constant-potential alternator of 120 HP. The mill contains 20 stamps of 750 lbs., four wide-belt (6 ft.) fine vanners, eight continuous-process amalgamating pans (two of which are constantly grinding), three settlers, one agitator, one pan and settler devoted to the amalgamation of concentrates, a bucket elevator, a worm gear hoist and a rock crusher. In order to determine accruately the capacity of motor required, a number of cards were taken with the Tabor indicator from the 20 × 36-in. steam engine that drove the mill, showing an average of 90 and a maximum of 101½ HP.

On the armature shaft of the motor is a friction wheel, and beyond this a clutch, which is used to set in motion the driving pulley and the machinery of the mill. On the same bed-plate with the motor is a small 10 HP. Tesla starting motor, with a wooden pulley on

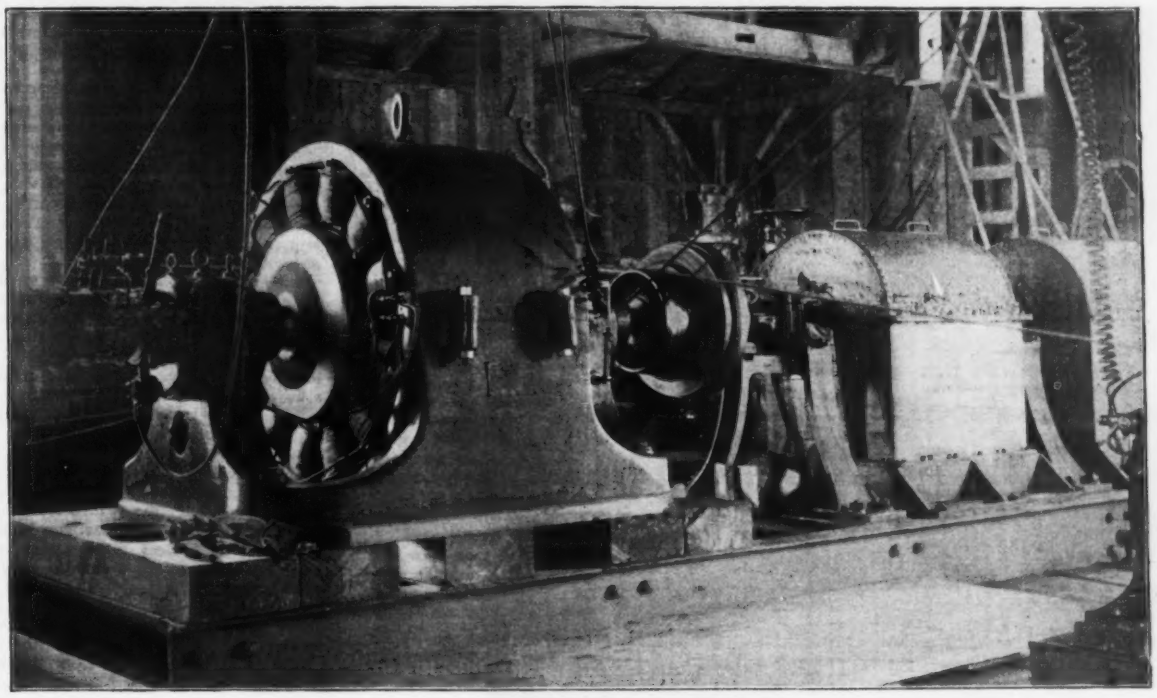


FIG. 3. GENERATOR AND PELTON WHEELS IN OPERATION AT POWER HOUSE.

its shaft, that is brought to bear against the friction wheel mentioned by means of a screw and hand wheel. This Tesla motor consists simply of field coils and an armature; it has neither brushes, nor commutator, nor sliding contacts of any kind. The alternating current is led directly into the fields, the stationary element, the coils of which, being connected in series, produce a rotating magnetic field, in that each pole is alternately positive and negative. The starting torque of the armature is in consequence very low, and it has to receive several rapid turns by hand before putting on the current, after which it generally runs up to normal speed (1,660 revolutions) within a minute.

Turning our attention to the switchboard, shown in Fig. 4, the two plugs in the sockets on the right of

FIG. 4. MOTOR SWITCHBOARD IN MILL AT BODIE.

the board are the line plugs, and the two to the left of them, in their rests, are the starting motor plugs. When the line plugs are in their sockets, the current is led directly to the top of the upper jaw switch, and this switch is never closed until the machines are in synchronism. The wires from the bottom of this switch lead directly to the collector rings on the armature shaft of the motor.

In the upper right-hand of the board is the Wurts lightning arrester, consisting of 22 spools, 11 on a side, separated each by a distance of 1-32 in. Both legs of the wire line are attached to the arrester, one on each side at the top, while the ground wire leads from the bottom spools to a water pipe in the earth. The spools are made of a patent non-arcing metal, and it is claimed that the dynamo current will therefore not follow the path through them made by a discharge of high-tension atmospheric electricity.

To start the motor requires two men, one to handle the starting motor and the other at the switchboard. The line plugs are put in, which leads the main current to the top of the synchronizing switch, and the lower jaw switch is thrown in, which closes the field-circuit of the motor, and the secondary of the main line or generator converter, thereby lighting the upper lamp of the synchronizer. The armature of the starting motor is turned a few times by hand, and the two left-hand plugs are then pushed into their sockets, leading the current from the main line to the fields of this motor.

Immediately upon doing this, the main current ammeter records 30 amperes, and the needle stays at this reading until the starting motor is up to speed, when it drops quickly to 18 to 20 amperes. It takes from 50 to 70 seconds for the starting motor to reach full speed, after which its friction wheel is brought to bear against that of the main motor, and the armature of the latter begins to revolve. During this time the synchronizing switch is open, and all the resistance coils of the rheostat are left in the field-circuit, in order that the armature may more easily be brought up to speed, by preventing the flow of current in the same.

As soon as the armature is above speed, about two-thirds of the rheostat is thrown out, permitting 40 to 50 amperes of current to flow, and the lower lamp of the synchronizer to burn. The pushing on to its button of the little switch on the bottom of the synchronizer now connects the two central lamps in series with the motor and the generator currents, and they begin to flash in accordance with the phases, and therefore the speeds, of the two machines. As the speed of the motor approaches that of the generator, the wave phases come nearer coincidence, and these lamps brighten and darken almost simultaneously.

The attendant stands with one hand on the rheostat and the other on the open jaw switch, watching these waves of light intently, and just as the two lamps darken in unison, he throws in the switch and pulls one of the starting motor plugs. The lamps only remain "out" for a second or less, while the speeds are together, and then flash up brightly again as the motor speed drops off; there is therefore but a fraction of a second during which the jaw switch should be closed, though this time can be lengthened slightly by a proper handling of the starting motor.

If this switch has been thrown in at the right moment, the series lights remain "out," while the top and bottom, or "pilot" lights, burn brightly, and so continue all the while the machines are in operation. If the switch is thrown in a second or so too soon, the main current ammeter will fly up to 40 or 45 amperes, and quickly drop down to less than 10 as the motor speed decreases, and it falls into step with the generator; while the series lamps will remain dark, and the pilot lamps burn as usual. On the other hand, if it is closed several seconds too soon, or a fraction of a second too late, it is impossible for the machines to get into synchronism. In such event all the lights on the synchronizer go out at once, and a heavy flow of current sets in, the main ammeter showing 45 amperes, which is as high as it can record. By the extinction of the lights the attendant sees at once that he has missed the synchronizing point, and immediately pulls the main line plug, opens the jaw switch, and starts over again. The second trial, however, will not consume as much time as the first, since the starting motor is still revolving at a high speed, and more quickly comes up to its normal rate, while the motor armature is also still running at several hundred revolutions per minute.

It will be noticed that in order to break the circuit and stop the motor it is necessary to pull the line plug, on doing which a brilliant arc, sometimes 2 ft. in length, if 25 amperes are flowing, follows out from the socket to the plug tip. Any attempt to open the jaw switch while the line plugs are in would doubtless result in the death of whoever tried it, since the distance is too short in which to break the arc, and the current would probably follow down the arm in spite of one's standing on an insulated floor.* These floors are used around both generator and motor, and in front of both switchboards.

The entire operation of starting up the motor from a state of rest occupies from three to five minutes, and when once in synchronism, the clutch can be thrown in and the mill shafting brought to normal speed in from one to two minutes more, after which the load may be thrown on as fast as desired. The clutch is always thrown in slowly in order to prevent too heavy a flow of current, and consequent sparking of the commutator brushes.

By means of a single counter shaft, fitted with self-oiling boxes, the high speed of the motor (860 revolutions) is reduced to the necessary 80 revolutions of the battery line shaft; the reductions being 2 ft. to 8 ft., and 3 ft. to 8 ft. Light steel rim balanced pulleys are used, and an endless 16-in. double leather belt runs from the motor to the first 8-ft. pulley. The speed of this belt is 5,400 ft. per minute, and it is kept tight by levers, which, acting through screws, move the entire motor and its bed-plate along four grooved cast iron slides.

The motor is separated from the underlying brick foundation by means of 8 × 10-in. timbers, which are bolted to the latter and covered by three layers of 1-in. boards; and to this wood insulation the slides referred to are fastened by lag screws that pass through the boards into the timbers. The generator is insulated from the I-beams that carry both it and the water wheels, by timbers 5½ ins. thick, to which it is likewise secured by lag screws.

The mill and offices of the company are lit by 100-volt incandescent lamps, taking current from a large 100-light converter, ratio 30 to 1, which is attached to the main line in the motor room, before it reaches the switchboard. The light is very satisfactory, even to read or write by, although at times the lamps flicker slightly, due to small changes of load. This variation of intensity is of course unavoidable where the lighting current is taken direct from a power circuit; but, in the present case at least, is not sufficiently noticeable to cause inconvenience.

During normal operation of the plant, the field ammeter of the motor is, by means of the rheostat, kept steadily at 52 amperes, while with full load on the mill the main current ammeter registers from 23 to 25 amperes. The needle oscillates over a range of 4 to 6 amperes, showing considerable variation of load, due undoubtedly to slipping of the belts, unequal resistance of the grinding pans, rock crusher, etc., so that it is difficult to read this ammefer closely, either at the geuerator or at the motor.

The average amperes of current can be very closely

* Several years ago, when high-tension currents were not so commonly in use as now, on a 2,000-volt circuit installed in France, large jaw switches were used set high up on the switchboard, so that the attendant had to spring upwards to reach them, and was therefore always in the air when either breaking or closing the circuit.

approximated, however, as was done in the tabulated readings given below, which were taken with the object of determining the line loss, and with the aid of Mr. H. M. Reed, the efficient engineer of the Westinghouse Electric & Mfg. Co., who installed and first operated this apparatus.

The readings were taken simultaneously at power house and motor room by means of the telephone, and the figures given are the averages of five or six consecutive observations. There being no voltmeter on the motor switchboard, a Weston portable voltmeter was used, the wires being attached to the lower posts on the synchronizer.

The table is merely a rough approximation of the efficiency of the transmission, there being no instruments at hand for close work, such as the measurement of the wheel shaft energy, or the determination of the true efficiency of the motor and generator. This efficiency is taken in the table at 90%, the Westinghouse Co. claiming as high as 96% for its machines under full load. This load it is impossible to give them at present, as full mill load represents but 75 to 80% of their capacity.

It will be noticed that, as the dynamo and motor approach their rated capacity, the efficiency of the transmission increases. The line loss is undoubtedly light for even so moderate a current; but the fact that the tests were made in the winter, when the temperature along the line was below freezing, may have some bearing upon this point.

From the foregoing description it will be seen that the operation of starting the motor is one requiring considerable practice. The proper setting of the brushes on the commutator of the motor armature is also a knack acquired only by experience; and for a while considerable trouble was caused by undue sparking at these brushes. Experience on the part of the attendants has entirely overcome this; but it has been found necessary to use two commutators, keeping one always turned and polished ready for use, and changing them usually after 25 to 30 days of steady operation.

In order to stop the motor, the load is thrown off by means of the clutch, and the line plug is then pulled. Should the plug be pulled without first throwing off the load, a momentary rise in electro-motive force may follow, sufficient to damage an armature coil. This has happened once in our experience; and the very high potential was vividly shown by the discharge through the lightning arresters at both ends of the line.

The dependence of the motor speed upon the alternations of the generator is very prettily shown, when, without pulling the line plugs, the machines are stopped by shutting off the water on the wheels. The motor then slows down in exact accordance with the generator, and is at rest within half a minute or so; whereas, when the plug is pulled in the usual way, the motor armature will revolve for several minutes from its own momentum, before coming to a stop.

cellent test on both the starting motor and machines, as at such times the difference in potential, and consequently the strain on the insulation, are likely to be a maximum.

The entire cost of this plant does not exceed $38,000, while its operation during the month of October alone effected a saving of $2,100, equivalent to $1.46 per ton of ore crushed, and reducing the total milling cost to $2.32 per ton; a fairly low figure for a high-priced camp (wages $4 per day), such as Bodie. At present the plant is operating most smoothly, and is successfully demonstrating the effectiveness and simplicity of the single-phase synchronous system for such work and distances, while the daily saving over the use of steam, on 12-hour runs, is from $35 to $40.

Since the preparation of this paper in February, 1894, an acoustic synchronizer has been added to the phase lamp device on the motor switchboard, and has proved a great aid in the operation of synchronizing the machines. In fact, it is an extremely rare occurrence for the motor attendant to miss the moment of synchronism.

A few minor changes have been made, such as the replacing of the oak insulation, in the coupling of the generator and water wheel shafts, by a hard rubber disk, projecting about an inch beyond the flanges of the coupling. This was found necessary on account of the splitting of the oak disk, giving surface for the passage, through the coupling to ground, of high-tension electricity, with which, during wind storms, the wire line is sometimes charged from the atmosphere.

By the use of the lower voltage lamps in the ground detector on the generator switchboard, and a change in the ground wire attachment, this instrument has been greatly improved; and, while no "grounds" have yet occurred on the line, there is no doubt that the detector is now in shape to indicate them with accuracy. Without the ground connection made, the lamps now show a red light on the filaments, due to the difference in potential of the two sides of the line; and, should a "ground" occur on either leg, the corresponding lamp immediately burns at full candle-power, while the other lamp proportionately diminishes.

The only trouble now experienced with this plant comes from an extraneous source, common, in a greater or less degree, to all electrical plants throughout the world, namely, occasional incursions of lightning during thunderstorms; or from another, more local cause, already alluded to, namely, discharges of static electricity, due to a gradual charging of the line from a highly charged atmosphere, during wind storms.

These have several times caused the burning out of armature coils; but this matter is not as serious as it may seem, since but a couple of hours are required to repair such damage. To put in a new coil, the top half of the field of the machine, weighing about two tons, is swung off by means of differential blocks and an overhead trolley; the burnt coil is cut out with a hack

Approximate Efficiency of the 12-Mile Transmission.

Date.	Generator. Volts.	Generator. Amperes.	Generator. Mech. HP. given out.	H P. given out by w.-wheels, allowing 90 per cent. efficiency for generator and adding 5 HP. for exciter.	Motor. Volts.	Motor. Amperes.	Motor. Mech. HP. delivered to motor.	Line loss.	Mech. HP. given out by motor, allowing 90 per cent. efficiency.	Approx. per cent. of full mill-load driven at time of test.	Approx. per cent. of water power at motor pulley.
Dec. 22	3,390	20	90.9	106.0	3,150	25	105.5	8.0	95.0	105	71.8
" 29	3,390	21	95.4	111.0	3,120	23	96.2	8.0	86.6	95	71.5
Jan. 16	3,390	23	104.5	121.1	3,100	21	87.3	8.6	78.5	85	70.7
Feb. 1	3,420	25	114.6	132.3	3,090	20	82.8	8.9	74.5	82	70.3

Note.—During the above tests the exciter was being driven from the wheel-shaft, instead of by its separate water-motor; hence, the allowance of 5 HP.

The first trials of this plant last summer developed electrical defects resulting in accidents more or less serious to both machines; and Messrs. Reed and Winslow, Westinghouse engineers, deserve much credit for the manner in which they met and conquered these difficulties. There was no trouble with the wire line—it has carried the 3,000 volt current through all kinds of weather—but the current succeeded in escaping at the machines themselves, through alternating current brush holders, and armature coils, and even at the synchronizing jaw switch. In almost every instance, the remedy was heavier insulation at the point of escape, resulting almost invariably in a cure of the evil.

It is probably more advisable on machines of this size to use a potential not exceeding 2,000 volts, or, if the length of the transmission necessitates a higher tension in order to avoid excessive cost of copper, then to use step-up and step-down transformers.

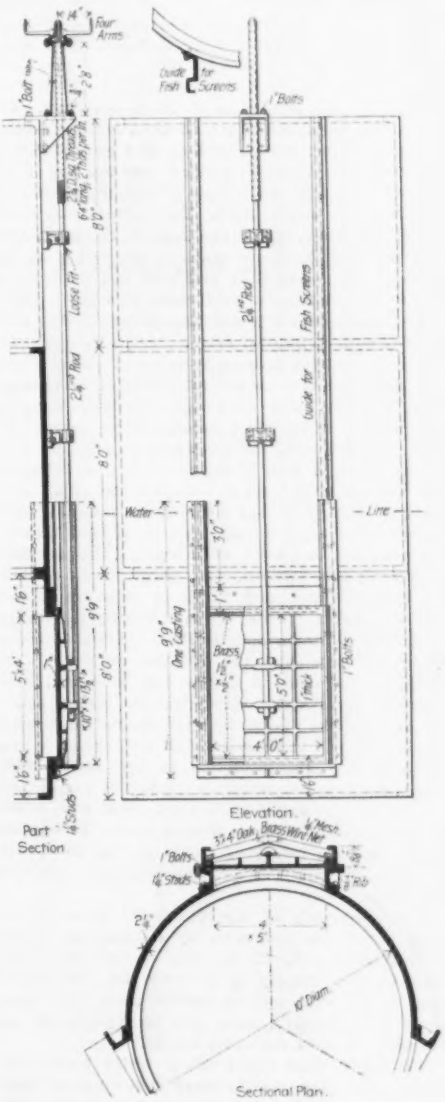
This plant has accomplished several unbroken runs, day and night, one of 13 days and another of 20 days' duration, but latterly it has been operated more intermittently, on account of the mill being run upon only half time. During December, 1893, the plant was started 23 times in 21 days, and in January 11 times in as many days (in accordance with the requirements of the milling work), these daily startings being an ex-

saw; the new coil is slipped over the tooth and squeezed into place by means of specially made geared clamps; the connections are soldered, taped and painted; and the top field is then replaced in position.

A proper arrangement of lightning arresters and impeding or "choke" coils, now being introduced, bids fair to protect the machines entirely against all danger from lightning; while the grounding of the wire line at each end through inductive resistance sufficiently high to prevent any appreciable loss of current, will prevent damage from these static charges, as they will be leaked to earth as fast as accummulated, and without the occurrence of disruptive discharges.

CAST IRON SHAFT AND INLET GATES, HYDE PARK TUNNEL, CHICAGO WATER-WORKS.

The Hyde Park, or 68th St., tunnel of the Chicago water-works was described and illustrated in our issue of May 31, 1894. The details of the cast iron shaft and the gates admitting water to the shaft were received too late for use in the above-named issue, and are shown by the accompanying cut, which needs no further explanation. The shaft and gates are similar if not identical in design with those used for the intake crib of the four-mile tunnel. The latter tunnel was described at length in our issue of July 5, 1890, but the details of the shaft were not presented at that time. We are indebted to Mr. John Ericson, Assistant City Engineer of Chicago, and in charge of the Hyde Park tunnel work, for the drawings from which the illustration was prepared.



Cast Iron Intake Shaft, Chicago Water-Works.

WATER-POWER DEVELOPMENT AT RUMFORD FALLS, ME.

The development of water-power for manufacturing purposes, which a few years ago was almost at a standstill, has received a wonderful impetus in recent years through the demand for large amounts of power for the generation of electricity and the possibility of the transmission of power by electricity over long distances. It is somewhat of a novelty at the present time, therefore, to hear of a large water-power development enterprise in which electricity plays no part. Such a one, however, is now in progress at Rumford Falls, Me., and presents many features of interest to the engineer. At this point the Androscoggin River has a total fall of 180 ft. in a distance of only a mile, and its large volume and constant flow makes a total power available of some 50,000 HP. The river above Rumford Falls drains an area of over 2,320 sq. miles. The area of lake and pond surface tributary to the river is about 130 sq. miles, of which 91 sq. miles are contained in the Rangeley

lake system, the head waters of the river. The Union Water Power Co., of Lewiston, at a cost of nearly a million dollars, has constructed dams to control the water of these lakes and thereby convert them into reservoirs. For the utilization of the power, three canals, the upper, middle and lower level, will be built. At the present time the whole of the middle level and part of the lower level canals are already constructed. The upper level canal will be 150 ft. above, and the lower level 50 ft. below the middle canal. The lower level will have a head of 30 ft. to the river. The mills built along the canals, besides receiving water from the river, are enabled by this terrace system to utilize a second and a third time the power employed in turning the wheels of manufactories situated on the upper level. Two substantial dams have been built; one at the head of the upper falls has recently been constructed; the other at the head of the lower falls and near the entrance to the middle canal was built some two years ago.

The upper dam is a crib dam, about 250 ft. long, which, with a natural ledge, gives a roll-way 700 ft. long. It will give eight miles of slack water, and 300 acres of boomage for sawmills. The lower dam is 380 ft. long. Just above the lower dam are the middle canal head gates, which control the flow of water from the river into this canal. J. S. Smith & Co. of New York, were the contractors on the middle level canal. Part of the canal is a natural waterway and used to be annually overflowed; the remainder and greater portion was excavated and is paved with stone. The territory excavated was made up to a great extent of huge boulders covered and filled in with sand and gravel deposit. The canal is 2,400 ft. long, from 90 to 200 ft. wide, and 20 ft. deep. Its cost was about $85,000. For the further control of the water in the canal a waste way has been built near the headgates. Whenever the water has a tendency to rise above the level of this waste way, the surplus will at once drain off into the river at a point below. The openings in the canal bank through which the water is conducted to the mill wheels are protected from logs, bark and debris of all kinds by screens of iron bars. The canal, besides serving to supply power to the mills, will also serve to carry logs to the paper and sulphite companies.

The excavating of the completed part of the lower canal has been done by Everson & Liddle, of Providence, R. I. Enough of the canal has been built to supply a tail-race for the water used in the mills on the middle level, but when the work is finished, there will be opportunity for mill sites as upon the other canals.

The upper level canal takes water above the upper falls. The middle level takes water from above the second falls, and discharges into the lower level, which is at an angle to it, across its end, and which discharges below the lower falls. The upper canal will give 25,000 HP., with 100 ft. fall; the middle canal will give 12,000 HP. (8,000 HP. already utilized) under 50 ft. fall; and the lower canal will give 7,000 HP. with 30 ft. fall to the river.

The Rumford Falls Paper Co. has a pulp and paper mill plant covering about two acres. In the grinding room are 20 grinding machines for reducing the wood to pulp, and four 42-in. Hercules water-wheels of 1,000 HP. In the paper mill are five more of these wheels, one 39-in. wheel of 800 HP., and four 30-in. wheels of 132 HP. each, the latter, driving the four paper machines, having capacities of 12½ to 18 tons of paper per 24 hours. The paper is made for newspaper work only and the present aggregate capacity of the mill is 120,000 lbs. of paper per 24 hours, but two new machines are to be put in to increase the capacity. The Rumford Falls Sulphite Co. is now putting in a plant for the manufacture of pulp by the sulphite process.

The town of Rumford Falls is at the end of a branch of the Maine Central R. R. It has four miles of streets lighted with electricity, two miles of water mains and half a mile of sewers. The present population is about 2,100. The water power plant is being built by the Rumford Falls Water Power Co., of which Mr. J. Herbert Shedd, M. Am. Soc. C. E., is consulting engineer and Mr. Mixer is the resident engineer.

Four-cylinder compound locomotives are being introduced on the Paris, Lyons & Mediterranean Railway, France. These engines have four coupled driving wheels and a leading truck with two or four wheels. There are four cylinders; the high pressure ones are outside the frames of the locomotives between the front driving wheel and the rear truck wheel, and are connected to the rear drivers, while the low pressure cylinders are between the frames over the center of the truck and are coupled to the front drivers. In the 1888 type of engine the weight was 117,900 lbs., while the latest type weighs but 99,200 lbs. This reduction in weight was obtained by substituting steel for copper in fireboxes, after the American custom, and by reducing the length of the boiler from 13 ft. 3 ins. to 9 ft. 10 ins. The latter important change was made after some noteworthy experiments on boiler construction had been carried out by the engineers of the company, and it was found that with ribbed tubes 2.56 ins. diameter the maximum evaporation is obtained when they are 9.84 ft. long, which length has been adopted in the new engines. The capacity of the cylinders has also been increased 29%, so that now they are 13.39 and 21.26 ins. diameter with a stroke of 24.4 ins. The Walschaert valve gear is used for the high-pressure cylinders, and an independent motion of special design, without eccentrics, for the others. Both are controlled by a single steam reversing gear so arranged that a definite ratio of expansion in the high and low-pressure cylinders is always maintained. The new engines are found to not only weigh less and be more economical than the older type, but to evaporate more water in spite of the smaller boiler.

The use of electric machinery on naval vessels for lighting and power purposes is increasing rapidly, and in a recent paper on this subject, Lieutenant Murdock suggests that electric motors will be advantageous on shipboard as follows: 1. In all places where auxiliary engines operate continuously for extended periods, the steam and exhaust pipes necessarily passing through storerooms or living spaces. 2. For ordnance purposes where the demands for power are not excessive. 3. In isolated places, such as military tops, where power is necessary. On the other hand, they are inadvisable: 1. In engine or fire rooms, where steam is always available, and the conditions are unfavorable for the durability of motors. In general where the demands for power are excessive and steam is available, as in the windlass engine. 3. Where rapid and frequent reversals are necessary, as in the steering engine. The conditions existing aboard men-of-war are especially trying to dynamo apparatus, and even with the best of care deterioration is more rapid than is usual ashore. The continuous operation of the dynamos, the high temperature of the dynamo-rooms, the presence of salt water and salt air, and the inevitable wear and tear attendant upon the crowded condition of the ships, are all difficulties to be encountered.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

BALTIMORE & DRUM POINT.—The construction of this railway has been again suspended, but it is reported probable that the cessation will be for a short time only. The road is under construction from Baltimore to Drum Point, 82 miles, and is expected to be completed within a year. Contractors, Van Aiken & Hayes, Washington. Ch. Engr., D. H. Howell, Union Bldg., Washington.

Projects and Surveys.

AMSTERDAM, JOHNSTOWN & GLOVERSVILLE.—Lawton Caton, Gloversville, N. Y., is reported as in charge of the engineers who are making surveys for this proposed railway, noted last week. It is stated that a part of the road will be built this fall.

BEAVER MEADOW, TRESCKOW & NEW BOSTON.—Bids are asked until Aug. 1 for moving about 12,000 cu. yds. of earth and rock at Coleraine Colliery, as stated in our advertising columns. Pres., A. S. Van Wickle, Hazleton, Pa.

BLACK RIVER.—It is stated that Geo. A. Ayer, Ch. Engr., Perkinsville, Vt., is about to award contracts for constructing 11 one-mile sections of this projected railway.

CANADIAN SUBSIDIES.—A resolution has been introduced in the Canadian parliament by the government, according to reports, granting the following subsidies to railways projected or in course of construction: Bracebridge & Baysville, for 15 miles from Bracebridge toward Bayville, a subsidy not exceeding in the whole $48,000; Brockville, Westport & Sault Ste. Marie, the balance remaining unpaid of the subsidy previously granted not exceeding in the whole $86,800; Tilsonburg, Lake Erie & Pacific for 16 miles from Port Burwell to Tilsonburg, not exceeding in the whole $51,200; Brantford, Waterloo & Lake Erie for 18 miles from the town of Brantford to the village of Hagarsville or Waterford, or some intermediate point on the Canada Southern, not exceeding in the whole $4,790; St. Catherines & Niagara Central, for 34 miles from St. Catherines to Hamilton, representing a grant in cash of $108,000; Montreal & Ottawa (formerly the Vaudreuil & Prescott), for 61 miles toward Ottawa, not exceeding in the whole $118,400; Quebec Central, upon the completion of its line from a point between the Chaudiere River and Tring Station to a point on the International Ry. near Lake Megantic, $228,000; Joliette & St. Jean de Matha Ry. Co. for 8 miles from St. Felix de Valois to St. Jean de Matha, Que., not exceeding in the whole $25,600; Lake Temiscamingue Colonization, for 50 miles from Mattawa to the crossing of the Kippewa River, also 15% on the value of a wooden truss bridge over the Ottawa River, not to exceed $15,000 in all, in lieu of subsidies granted; also the balance remaining unpaid of the subsidy granted for the railway from Long Sault to Lake Kippewa, a subsidy not exceeding $3,200 per mile and 15% on the value of the bridges, also a sum of $1,750 additional per mile on the 50 miles from Mattawa to the crossing of the Kippewa River, not exceeding in the whole $274,940; Great Northern Ry. Co., for 30 miles from a point on the Canadian Pacific near Maskinonge or Louisville, toward the parish of St. Michel des Saints, on the River Mattawa, in lieu of the subsidies granted to the Maskinonge & Nipissing Ry. Co., not exceeding in the whole $96,000; from St. Placide to St. Andrews, 8 miles, a subsidy not exceeding $25,600; for a railway from St. Eustache to St. Placide, for 18 miles, subsidy not exceeding $57,600; for a railway from a point on the line of the Canadian Pacific in the county of Laval, towards St. Eustache, for 12 miles in lieu of the subsidy granted to the Carillon & Grenville Ry., for 12 miles from St. Eustache to Sault au Recollet, a subsidy not exceeding in the whole $38,400; for a railway from the parish of St. Remi, in the county of Napierville, to St. Cyprien, for 12 miles, not exceeding in the whole $38,400; Pontiac Pacific Junction for bridging the several channels of the Ottawa River at Culbute and West, a subsidy of $31,500; Pontiac Pacific Junction Ry., for 7½ miles of railway from Hull to Aylmer, not exceeding in the whole $24,000; Pontiac Pacific Junction, for 85 miles from Aylmer to Pembroke, not exceeding in the whole $73,172; to the Harvey Branch Ry. Co., for 3 miles of railway from the southern terminus of the Albert railway to Harvey Bank, not exceeding in the whole, $4,046; for a railway from a point on the Intercolonial railway near Newcastle or via Douglastown, to a point on the River Miramichi, opposite the town of Chatham, in the Province of New Brunswick, 6 miles, a subsidy not exceeding, $19,200; for a railway from some point on the Joggins railway, near the Hebert River, to Young's Mills, in the Province of Nova Scotia, a subsidy not exceeding in the whole $16,000; Woodstock & Centreville R. R., for a railway from Woodstock to the international boundary between the Province of New Brunswick and the state of Maine, 26 miles, a subsidy not exceeding $83,200.

CAPE COD SOUTH SIDE.—Incorporated in Massachusetts to build the railway projected from Falmouth to Hyannis; capital stock, $10,000; F. W. Parsons, Osterville, Mass.; Chas. H. Nye, formerly Supt. Cape Cod Div., Old Colony; W. N. Kellen, S. L. Leonard, Boston; Frank A. Nye, North Falmouth, Mass., and others.

Southern—Projects and Surveys.

CHEAT RIVER.—A report from Piedmont, W. Va., states that Jonathan Barrett, who has had charge of the work of the defunct Black Bottle R. R., has been engaged to make surveys for this proposed railway. The road will probably extend from Rowlesburg, W. Va., on the Baltimore & Ohio, up Cheat River to a connection with the West Virginia Central. Pres., W. S. Guffey, Pittsburg, Pa.

Northwest—Existing Roads.

PORT ARTHUR, DULUTH & WESTERN.—This company is reported to have been granted a bonus of $4,500 a mile by the Canadian parliament for extending its line from the present terminus near the international boundary line, to the eastern end of Rainy Lake, Minn., to the recently discovered gold fields.

Projects and Surveys.

CHICAGO-MILWAUKEE TERMINAL & BELT LINE.—This company has been organized at Milwaukee to build a terminal in that city to accommodate seven railways and to build a road along the lake shore to Waukegan, Ill., connecting there with the outer Chicago Belt Line. The projectors of the enterprise are said to have secured the right of way through the manufacturing portions of Milwaukee and to the foot of Broadway on the south side of the city, also 70 acres just outside of the city limits for an outer terminal yard and 3½ miles of right of way 100 ft. wide to the heart of the city, besides valuable dock property, etc., all representing a present outlay of $2,500,000. It is stated that the road will be built within two years. Capt. Fred Pabst, Burnham Bros., Pfister & Vogel Leather Co., Durr & Rugee, John Black, T. L. Kelly, and the Milwaukee Merchants' Association are among the local parties reported as interested. Capital stock, $6,000,000.

IOWA, LAKE SUPERIOR & GULF.—Incorporated at Lincoln, Neb., by A. J. Westfall and others to build a railway from Duluth, Minn., to Bolivar, Tex.; capital stock, $1,000,000.

MILWAUKEE BELT & TERMINAL.—This company was formed several years ago to build a belt and terminal railway at Milwaukee, according to reports, and has recently given a mortgage for $2,500,000 to secure an issue of bonds to construct its proposed road. Pres., Henry L. Faris, New York; Secy., Theo. B. Talbot.

Southwest—Existing Roads.

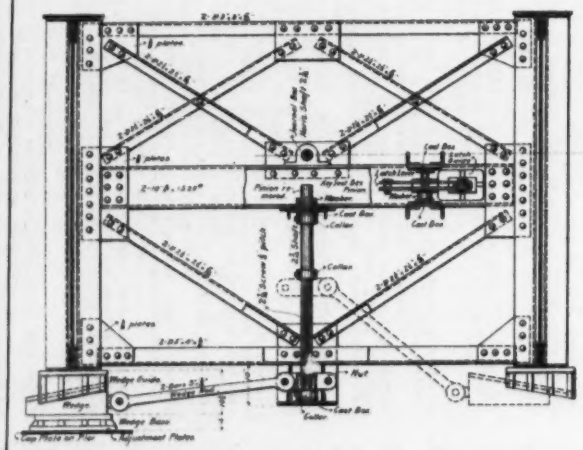
CHOCTAW COAL & RY.—A press report from South McAlester, Ind. T., states that J. B. Stuart, U. S. Judge for the Indian Territory, has given an order to sell the Choctaw Coal & Ry. equipment to the highest bidder on Sept. 8. Should the owners fail to pay all receivers' certificates now outstanding, about $800,000, the stock and bondholders have agreed to pay off this indebtedness, take the road out of the hands of a receiver and complete the road to Oakland City on or before Jan. 1 next.

GULF & INTERSTATE.—It is stated that the branch to Beaumont, Tex., will be built at once before commencing additional work on the line directly north.

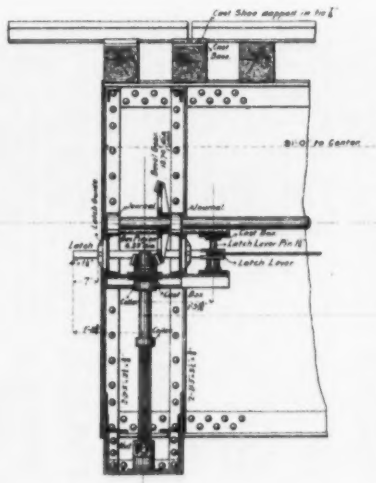
KANSAS CITY, PITTSBURG & GULF.—Press reports state that the capital stock of this company will be increased from $1,000,000 to $5,500,000 to extend the line from Siloam, Mo., to Shreveport, La., about 400 miles, and that the ultimate destination will be Sabine Pass, Tex.——Work was commenced at Pittsburg, Kan., July 19, on new shops to cost $165,000.

Projects and Surveys.

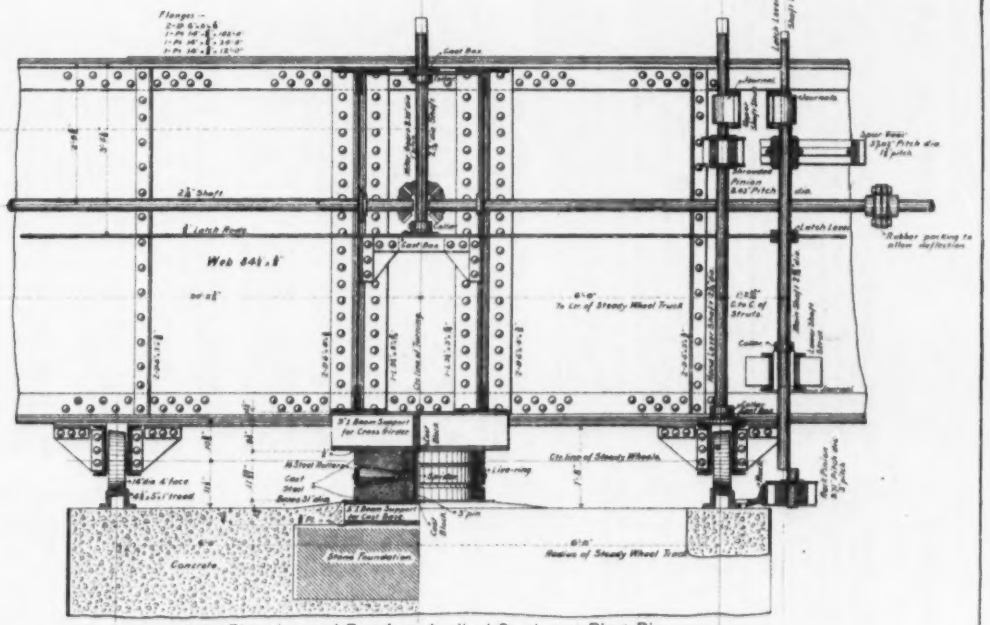
CORSICANA & SOUTHEASTERN.—The contract for constructing this projected railway, noted last week, has been awarded to Roche, Pierney & Co., Fort Worth, Tex., according to reports.



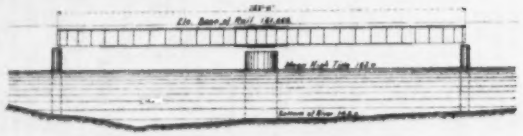
End Elevation Showing Wedge and Latch Connections.



Side Elevation at End.



Side Elevation and Part Longitudinal Section at Pivot Pier.



Profile with Diagram Elevation of Bridge.

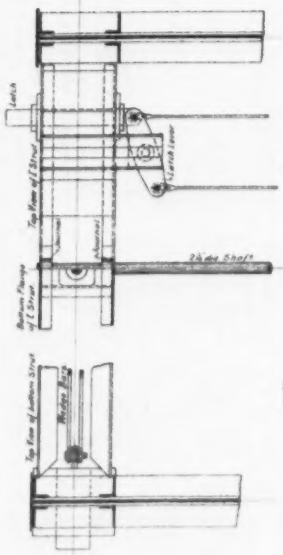
182-ft. Plate Girder Swing Bridge over the Patuxent River,

Washington & Chesapeake Beach Ry.

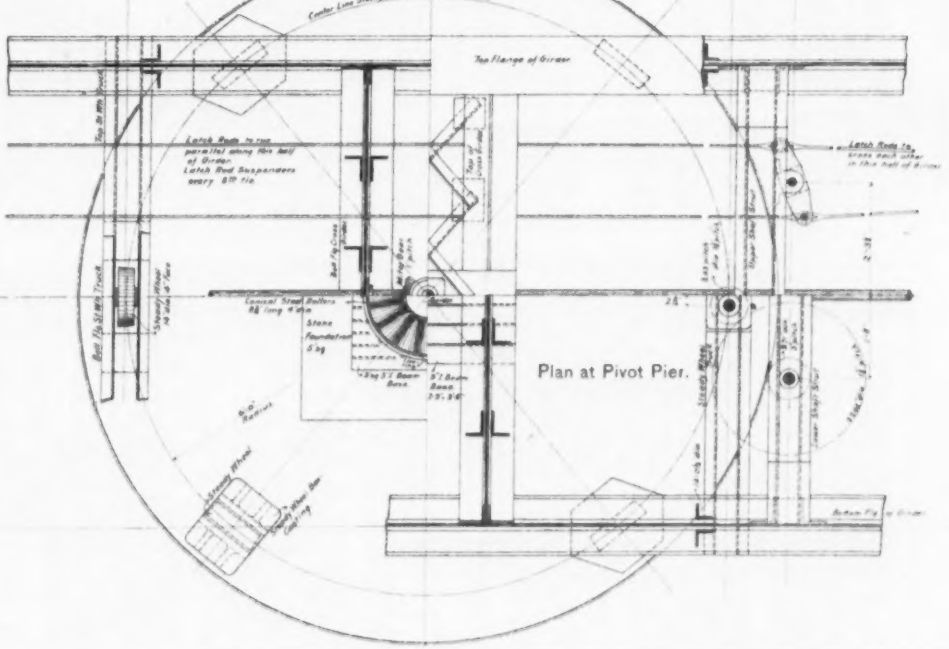
L. H. Hyer, Chief Engineer, Washington & Chesapeake Beach Ry.

C. E. Fowler, Assoc. M. Am. Soc. C. E., Chief Engineer, Youngstown Bridge Co.

Youngstown Bridge Co., Youngstown, O., Contractors.

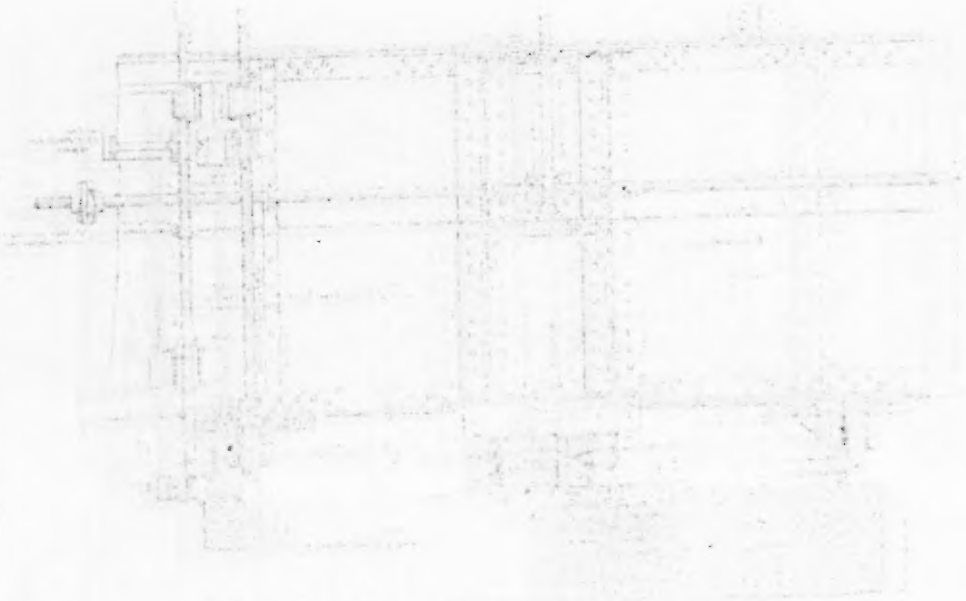


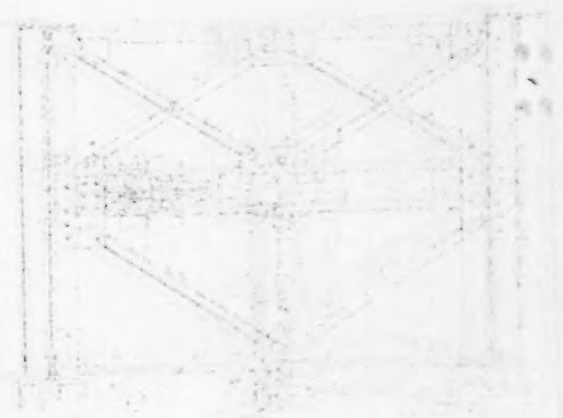
Plan at End of Span.



Plan at Pivot Pier.

CHAS. HART & SONS, LITH., 25 VESEY ST., N. Y.





KANSAS CITY, OKLAHOMA & PACIFIC.—The bill authorizing this company to build through the Indian and Oklahoma territories has been favorably reported to the House from the Indian Committee, according to a press report. The route is from near Coffeyville, Kan., south and west by the most practicable route near Pawhuska, Guthrie and Kingfisher, thence to the east line of Wheeler county, Tex., and on to Albuquerque, N. Mex. Several amendments are made. One provides for station grounds every ten, instead of every five, miles; another requires compensation to be made for the right of way across allotted lands; a third amendment changes the amount of damages to individual occupants from $20 to $50 per mile, and provides that this must be paid to the Secretary of the Interior for the benefit of the Indians in sums of $500 as fast as each ten miles of road is located and graded.

Rocky Mt. and Pacific—Existing Roads.

GREAT NORTHERN.—James J. Hill, Pres., has stated to the city council of Seattle, Wash., that the construction of freight and passenger terminals in that city will be commenced as soon as the necessary franchises are secured.

STREET AND ELECTRIC RAILWAYS.

MANCHESTER, N. H.—It is reported that definite steps are being taken to construct the proposed electric railway at an estimated cost of $100,000.

BROCKTON, MASS.—The Brockton & Stoughton St. Ry. Co., Brockton & E. Bridgewater St. Ry. Co., Brockton & Bridgewater St. Ry. Co. and Bridgewater & E. Bridgewater St. Ry. Co. have recently been incorporated, each with a capital stock of from $100,000 to $200,000; A. A. Glasier is treasurer and clerk of each company. A correspondent writes us that the above lines are branches of the Brockton St. Ry. and that the companies are chartered in the interest of the Industrial Improvement Co., of which Oliver Ames, Boston, is president.

CHICOPEE FALLS, MASS.—The aldermen have granted a franchise to the Springfield St. Ry. Co. to extend its line from this place to Holyoke. The extension will require the construction of two iron bridges.

COVENTRY, R. I.—The council is discussing the granting of a franchise to the Pawtuxet Valley Electric St. Ry. Co. to extend its line.

PAWTUCKET, R. I.—The Woonsocket St. Ry. Co. has voted to equip its Providence St. line with the trolley system.

AMSTERDAM, N. Y.—The Amsterdam, Johnstown & Gloversville R. R. Co., noted in our issue of last week as incorporated to construct a steam railway, will also build an electric railway to Rockton and Hagaman, according to reports.

COHOES, N. Y.—It is reported that $27,760 has been subscribed towards the construction of an electric street railway. The capital stock will be $50,000.

CORTLAND, N. Y.—Arrangements have been completed for building the electric street railway, according to reports.

SYRACUSE, N. Y.—The Syracuse St. R. R. Co. has purchased a site for a 130 × 200-ft. brick power house and a plant for supplying 1,200 HP., the plans for which will be prepared at once.

ATLANTIC CITY, N. J.—The Atlantic City St. Ry. Co. has been incorporated with a capital stock of $100,000 by J. J. Gardner, L. C. Alberton, C. C. Cole, C. J. Adams, of Granite City; I. G. Adams, Linwood; F. C. Somers, Camden.

BAYHEAD, N. J.—We are informed that an electric railway is being built between Point Pleasant and this place, and that the projectors state that the line will be extended to Lakewood, a distance of 12 miles.

BRADFORD, PA.—A franchise has been granted to the Bradford Electric St. Ry. Co. to extend its line.

GETTYSBURG, PA.—The officials of the Gettysburg Electric Ry. are discussing the practicability of extending the line to Union Mills.

LANCASTER, PA.—It is reported that the Pennsylvania Traction Co. has awarded contracts for constructing electric railways as follows: Lancaster to Manheim, by way of Lititz, 13 miles; Lancaster to Terre Hill, by way of Mechanicsburg, Bareville, New Holland and Blue Ball, 17 miles; Mechanicsburg to Ephrata, 8 miles; Lancaster to Strasburg, 7 miles, a total of 45 miles. The roads will be laid with 60-lb. T-rails. It is stated that as soon as these lines are in operation electric railways will be built from Millersville to Safe Harbor and from Strasburg to Quarryville.

PHILIPSBURG, PA.—The Clearfield Traction Co. has been incorporated with a capital stock of $10,000. Charles A. Bragg, Philadelphia, is one of the incorporators.

READING, PA.—A franchise has been granted to the Reading & Temple Electric Ry. Co. to construct an electric railway about 10 miles in length.

TARENTUM, PA.—Surveys have been completed for an electric railway to connect this place, Natrona, Springdale, Freeport and several other towns with Pittsburg.

ANNAPOLIS, MD.—It is reported that arrangements are being made to construct an electric railway from this city to Bay Ridge. Thos. C. Musgrave, Philadelphia, is interested.

BALTIMORE, MD.—The Baltimore, Middle River & Sparrows Point Ry. Co. is reported as soon to award the contract for the construction of its proposed electric lines, seven miles in length. Maj. T. B. Gatch, Pres., is reported as stating that $35,000 of the $50,000 of capital stock has been subscribed.

KEY WEST, FLA.—It is reported that a petition has been presented to the city commissioners for a franchise for an electric street railway.

COLUMBUS, O.—A franchise has been granted to L. D. Hagerty and others for an electric railway through Franklin and Madison counties. This is reported as being the first franchise secured for a proposed electric railway from this city to Cincinnati, a distance of 120 miles.

MARION, O.—An electric railway from this city to Mount Vernon is reported as proposed.

STEUBENVILLE, O.—The Steubenville Traction Co. has been incorporated with a capital stock of $100,000 to operate and extend the street railway; incorporators, Thomas Barclay, Thomas Johnson, G. W. McCook, Robt. Sherrard, William Stanton.

CHICAGO, ILL.—The Red Line Traction Co. has been incorporated to build, equip and operate street or elevated railways; incorporators, R. V. McNelhis, Frank Keogh and F. J. Hodgkins.——The West Chicago St. Ry. Co. will build a brick power house to cost $15,000. Arch., S. Potis, Jr.

STILLWATER, MINN.—The Stillwater Electric Ry. Co. has been incorporated with a capital stock of $75,000; Pres., Allan Curtis; Treas., G. E. Waring; Secy., J. C. Nethaway.

TEXARKANA, TEX.—The city is advertising in our proposal columns for a franchise for a street railway. Jno. Stewart, Cy. Secy.

SAN FRANCISCO, CAL.—George Whittell has petitioned the supervisors for a franchise for an electric railway on several streets.

HIGHWAYS.

NEW YORK.—Bids are asked by the supervisors of Richmond county, Stapleton, S. I., until July 31 for constructing seven macadam roads, as stated in our advertising columns. Henry P. Morrison, Engr.

NEBRASKA.—The Burt County Road Improvement Association has been organized at Tekamah. Pres., M. W. Blue; Treas., Charles Johnson.

BRIDGES AND TUNNELS.

BROCKTON, MASS.—Bids are asked until July 31 for the construction of a stone arch bridge over Indian Head River, between the towns of Hanover and Pembroke. Wm. Rankin.

COHOES, N. Y.—Bids are asked until Aug. 7 for the construction of an arch or waterway through Eagle's Nest Ravine. Address the city clerk.

LAWRENCE STATION, N. Y.—The Ocean Causeway of this place has been incorporated by Geo. C. Rand, Russel Sage, E. L. Rogers, F. B. Lord, J. H. Harper, and others, to construct and build a bridge across Rockaway Inlet in the town of Hempstead.

NEW BRUNSWICK, N. J.—The Middlesex board of freeholders has rescinded the contract for a bridge at Raritan Landing, at $29,500, as it is thought that a suitable bridge can be built for $15,000 to $18,000.

TAMPA, FLA.—At an election July 14 the citizens voted to issue $350,000 in bonds for a bridge and a sewer system, according to reports. Wm. C. Brown, Cy. Engr.

CINCINNATI, O.—Bids are asked until Aug. 10 for the construction of two 95-ft. plate girders and one 180-ft. through iron truss bridge on the line of the Alabama & Vicksburg Ry., as stated in our advertising columns. Ch. Engr., C. B. Nicholson; Pres., C. C. Harvey, 7th and Elm Sts.——The directors of the Cincinnati & South Covington St. Ry. Co. are considering the construction of a new bridge across the Ohio River. The company is at present paying more than $100,000 a year bridge rental, according to a reported statement of its attorney, ex-Governor J. B. Foraker.

CLEVELAND, O.—The following bids were received July 12 for the masonry and substructure of the Columbus St. bridge:

The L. P. & J. A. Smith Company	$57,255
Engel & Nicoll	53,410
John Gill & Sons	54,526
Fisher & Fisher (awarded contract)	53,015
John Stang	68,190
Spellacy & Craig	66,557

TOLEDO, O.—The county commissioners have decided to build a bridge over Ten-Mile Creek near Cash Upton's. Address Commissioner Engelhardt.

INDIANAPOLIS, IND.—The city engineer has completed the specifications for the proposed Raymond St. bridge.

CROSSWELL, MICH.—New bids will soon be asked for the construction of a bridge south of the town.

SUPERIOR, WIS.—The Wisconsin & New Duluth Bridge Co. has been incorporated with a capital stock of $1,000,000, by Geo. B. Hudnall, B. E. Yfertle, and J. M. McCabe. A bill has already been introduced in the House authorizing the company to construct a drawbridge over the St. Louis River, as stated last week.

HASTINGS, MINN.—The contract for the proposed bridge has been awarded to the Wisconsin Bridge & Iron Co., at $39,050. The bids were published July 12. Engr., Oscar Claussen, St. Paul.

MISSOULA, MONT.—Three railway bridges were destroyed near this city last week.

AUSTIN, TEX.—Bids are asked by the county commissioners until Aug. 6 for the construction of an iron bridge over Bull Creek.

CANYON CITY, ORE.—It is stated that Grant county, will spend $20,000 in replacing bridges recently destroyed by high water.

WINNIPEG, MAN.—H. N. Ruttan, Cy. Engr., writes us that the following bids were received July 14 for the superstructure of the Maryland St. bridge:

Iron Bridge.	
•Hamilton Bridge Co., Hamilton, Ont.	$12,500
Central Bridge & Eng. Co., Peterborough, Ont.	15,200
Dominion Bridge Co., Montreal	14,375
Chicago Bridge & Iron Co., Chicago	14,995
King Bridge Co., Cleveland	15,044
Gillette-Herzog Co., Minneapolis	14,300
Milwaukee Bridge & Iron Co., Milwaukee	15,429
Wooden Bridge.	
J. W. Buchanan, Winnipeg	$11,995
Rourke & Cass, Winnipeg	10,169
Milwaukee Bridge & Iron Co., Milwaukee	12,876

• Awarded contract.

WATER-WORKS.

DANFORTH, ME.—B. W. Stinchfield is canvassing the village for patrons for works, which are proposed by Portland parties, according to reports.

KITTERY, ME.—The Camden Land Co. has been organized to construct water-works, etc.; capital stock, $300,000; Pres., Wm. D. Lewis; Treas., Wm. H. Adams, both of Boston.

LEWISTON, ME.—J. L. Kenney, Supt., writes us that the city will require one 3,000,000-gallon pump and one 300-HP. water wheel, for which no contracts have yet been awarded. Arch., G. M. Coombs.

BARRE, MASS.—It is stated that Chas. A. Allen, Worcester, has reported that a storage reservoir and 1½ miles of mains can be constructed for about $20,000.

HUDSON, MASS.—The commissioners have been directed to investigate the cost of proposed extensions and report at an adjourned town meeting about Aug. 8.

NEWTON, MASS.—A company is reported to have offered to furnish the city with a daily supply of 2,000,000 gallons from artesian wells.

CROMWELL, CONN.—There is talk of securing a supply from the Portland mains, according to reports.

BROOKLYN, N. Y.—Bids are asked until Aug. 15 for pumping stations for an additional daily supply of 25,000,000 gallons, as stated in our advertising columns. Prospective bidders must file intentions in writing before Aug. 1. At a special meeting of the aldermen July 23 an appropriation of $750,000 was voted for this purpose. A. T. White, Comr. Cy. Wks.

BUFFALO, N. Y.—The following bids have been received for excavating and removing rock in conduits and wells and setting iron gate frames at the lower pumping station: Jas. B. Donnelly, $20,213; McNaughton & Bapst, $18,250; Wm. E. Hingston, $17,100; W. B. Wilson, $16,995; Dwyer & Huntington, $15,500; A. C. Douglas, Niagara Falls, $15,500 (informal); J. C. Green, $12,889; Fred J. Martin, $18,000.

COXSACKIE, N. Y.—Bids are asked until July 31 for the purchase of $35,000 in 4% water bonds. T. B. Alcott, Pres. Comrs.

HOMER, N. Y.—The works have been purchased by J. H. Moulton, Bangor, Me., for $20,000, according to reports, on mortgage foreclosure.

GLENS FALLS, N. Y.—Bids are asked by the village clerk until July 30 for certain extensions. E. B. Potter, Supt.

HAMILTON, N. Y.—B. J. Steinson, Village Clk., writes us that an election will be held Aug. 6 to vote on the question of works. Gen. W. M. West, Prof. J. M. Taylor and M. Tripp, Comrs.

JOHNSTOWN, N. Y.—Geo. S. Rice and Geo. E. Evans, Boston, have reported plans for an additional supply. The work will include a dam 15 to 25 ft. high and a 16-in. main. The estimated cost has not been made public, but it is stated that the commissioners will recommend an election for voting about $150,000 for the work.

NEW YORK, N. Y.—Bids are asked by the department of public works until Aug. 22 for furnishing materials and building an engine and boiler house, tower and chimney for high-service works at the new aqueduct, between Tenth Ave. and Harlem River.

OLEAN, N. Y.—Bids are asked until Aug. 11 for trenching in one street. J. F. LeFevre, Supt.

SYRACUSE, N. Y.—Bids are asked until Aug. 10 for trenching and pipelaying, as stated in our advertising columns. W. R. Hill, Ch. Engr.

WAPPINGER'S FALLS, N. Y.—There is talk of erecting a water tower.

ABBOTTSTOWN, PA.—It is stated that W. W. Hafer is about to put in works.

BEAVER FALLS, PA.—W. W. Kerr, Secy. Council, writes us that if the tests noted last week are satisfactory plans will be made and contracts awarded for new works. Consult. Engrs., James H. Harlow & Co., Times Bldg., Pittsburg.

DOWNINGTON, PA.—Thos. Halliday, Secy. Councils, writes us that the citizens have voted, 233 to 16, to issue bonds for works. The council is considering three plans: Artesian supply, estimated cost $26,000; pumping, $31,251; gravity, $27,750.

EDDYSTONE, PA.—A franchise has been granted to the Springfield Water Co.

FALLS CREEK, PA.—We are informed that arrangements are being made to put in works, for which surveys will soon be made. P. J. Gill, Secy.

HASTINGS, PA.—The council has been petitioned to construct works.

HAZLETON, PA.—The city engineer has been directed to make surveys for a supply from Nescopeck Creek.

KNOXVILLE, PA.—The council has appropriated $21,000 for the completion of the works.

MACUNGIE, PA.—The council has purchased a reservoir site at an elevation of 376 ft. above the village for the proposed works, noted July 12. About 17,000 ft. of 8 to 4-in. pipe will be required. John Erdman, Secy. Council.

McDONALD, PA.—Potter & Folwell, Engrs., Pittsburg, write us that the contracts for works have been awarded as follows: Pipe, Anniston Foundry Co.; pipelaying, Cronin & O'Herron, Pittsburg; valves and hydrants, Ludlow Valve Mfg. Co.; pumping, machinery, Snow Pump Co.; water tank, R. Munroe & Sons. The bids for a steel or wrought iron service reservoir were as follows: R. Munroe & Sons, $4,065; Armstrong Bros., $5,747; Riter & Conley, $5,945; Chandley Bros., $6,100; Curran & Hussey, $6,100. The other bids will be published in a later issue under Contract Prices.

MEADVILLE, PA.—The committee has reported against purchasing the plant of the Meadville Water Co., built in 1875, and in favor of constructing new works.

RANKIN, PA.—Bids are asked for constructing new works. W. H. Gordon, Clk., writes us that specifications are sent on application and that the construction will be commenced by Aug. 20.

RIDGWAY, PA.—An election will be held Aug. 14 to vote on an appropriation of $18,000 for extending the works and for other improvements.

WILKES BARRE, PA.—The council has given the water company until Nov. 1 to have its proposed filters in operation.

ABERDEEN, MD.—Bids will be received the first of next month for the construction of a gravity system estimated to cost about $15,000; capacity of reservoir, 500,000 gallons; works to be completed by Jan. 1. Engr., C. M. Johnson, Equitable Bldg., Baltimore. J. A. Swingley, Secy.

ANNAPOLIS, MD.—The itemized bids received July 19 for the proposed extensions, including a 2,000,000-gallon pumping engine, for the Annapolis Water Co. will be published in a later issue. Engrs., Jas. H. Harlow & Co., Pittsburg, Pa.

WESTERN PORT, MD.—The residents of Main St. are reported as negotiating for a supply from the Piedmont, W. Va., mains.

ALBANY, GA.—C. E. Buck, Pres. Frictionless Metal Co., Richmond, Va., has offered to put in a Pohle air lift pump and guarantee to increase the flow of the city's well from 350 to 450 gallons per minute, according to reports, for $3,000. An election will probably be held to vote on the question.

CADIZ, KY.—It is reported that the city is investigating the question of works. Address John F. White.

NEWPORT, KY.—The commissioners have decided to purchase a new pumping engine to take the place of the disabled one that recently broke down; estimated cost, $34,000.

TOLEDO, O.—The asylum trustees have contracted with E. Schreiber & Sons, Cincinnati, for the iron work, and A. Bentley & Son, Toledo, for the masonry for the proposed $8,000 water tower.

ANGOLA, IND.—Steps are being taken for works, according to reports.

MILFORD, IND.—The citizens are reported as wanting works.

WINCHESTER, IND.—An election will be held Aug. 6 to vote on the question of works.

OROSWELL, MICH.—An election will be held July 30 to vote on the issue of bonds for $9,000 for works.

SCHOOLCRAFT, MICH.—It is reported that bonds will be issued for works.

AURORA, ILL.—The city is about to issue $30,000 in bonds for extensions, voted July 2. J. M. Kennedy, Cy. Clk.

CHICAGO, ILL.—Bids are asked until July 31 for 5,000 pieces of 6-in. cast iron pipe. H. J. Jones, Comr. Pub. Wks.

EAST DUBUQUE, ILL.—Bids are asked until Aug. 2 for the construction of works. Consult. Engr., E. J. Spencer, Security Bldg., St. Louis. Geo. H. Most, Chn. Com.

LE ROY, ILL.—McGregor & Co., Bloomington, are reported to have received a contract for laying mains at this place.

MOLINE, ILL.—T. D. Wheelock, Ch. Engr., writes us that bonds for the proposed extensions have not yet been sold, and that consequently no contracts have been awarded.

ASHLAND, WIS.—M. T. Dozer, Cy. Engr., writes us that the Ashland Water Co. has sunk two successful test wells, and is now sinking a well 60 ft. in diameter, from which it is expected to get a daily supply of about 1,250,000 gallons. The well will probably be 35 ft. deep, and is being lined with brick. The foundation for the brick wall contains 100,000 ft. B. M. of plank, which is built upon and carried down as the work advances, the sand and water being removed by two centrifugal pumps.

MONROE, WIS.—Press reports state that W. H. Wheeler, Beloit, owner of the works here, will soon secure an artesian supply.

COGGON, IA.—Bids are asked until Aug. 1 for constructing works, consisting of an elevated tank, engine, pump house, mains, etc. J. W. Funk, Recdr.

WALKER, IA.—Bids are asked until Aug. 1 for works to cost about $3,000; supply from well; population, 500. Engr., Geo. W. Wynn, Cedar Rapids. O. C. Swartz, Recdr.

ALDEN, MINN.—The citizens have voted, 60 to 26, to issue $5,000 in bonds for works.

BLUE EARTH CITY, MINN.—Bids are asked until July 30 for the construction of works, including 20,000 ft. of 8 to 4-in. cast iron pipe, 40 hydrants, 20 gate valves and boxes, pipelaying and one fire pump. C. N. Brown, Village Recdr.

PRESTON, MINN.—An election was held July 24 to vote on an issue of bonds for $8,000 for works.

RUSHFORD, MINN.—It is reported that $10,000 in bonds have been voted for works.

FULLERTON, NEB.—Bids are asked until Aug. 9 for the construction of works and also for the purchase of $12,500 in water bonds. Engr., G. H. Ellsworth. S. H. Penny, Mayor.

SYRACUSE, NEB.—It is stated that an engineer has been engaged to make plans for works, estimated to cost $10,500.

ST. LOUIS, MO.—Bids are asked by the board of public improvements until Aug. 7 for 7,140 tons of water pipe, 200 tons of special castings, 261 stop valves, 275 fire plugs, and for laying the pipe.

BRENHAM, TEX.—The citizens are anxious to secure an artesian supply, according to reports.

COLEMAN, TEX.—It is reported that $15,000 in bonds will be issued for works.

GOLIAD, TEX.—L. A. Parker, Cy. Secy., writes us that there has been talk of putting in works as soon as the new court house is finished, but that no steps have yet been taken toward securing plans; population, 2,000

TEXARKANA, TEX.—Bids are asked for a franchise for water-works, sewers, electric light plant and a street railway, as stated in our advertising columns. John Stewart, Cy. Secy.

PORTLAND, ORE.—Bids are asked by the city treasurer until Aug. 5 for the purchase of $500,000 in water bonds.

MONROVIA, CAL.—The citizens have voted to construct works, according to reports.

CHATHAM, ONT.—A committee is investigating the question of an additional supply.

ARTESIAN WELLS.

EPHRAIM, UTAH.—Efforts are being made to organize a company to sink several artesian wells to a depth of 1,000 ft., according to reports.

WINNIPEG, MAN.—The "Free Press" states as follows: The provincial government is purchasing well boring machinery, and it is the intention to sink test wells at many places, particularly in the southern and northern parts of the province. The strike has delayed the arrival of the apparatus, but it is expected in a few days, and when it reaches here men will start for Arrow River, Morden and other places. Many districts have written to the department of agriculture showing the necessity of some work of this kind being done, and the premier has taken the course stated.

IRRIGATION.

ABILENE, KAN.—T. E. Dewey of this city has been appointed receiver of the Garden City Irrigation Co. The company was organized five years ago by T. W. Pelham, of this city, with a capital stock of $300,000, and has under its control 120 miles of ditches and laterals in Finney and Kearney counties.

SUMNER, NEB.—C. A. Edwards, Engr., writes us that the Platte Valley Irrigation Co. is planning to construct a ditch about 35 miles in length to irrigate 50,000 acres. W. A. Stewart, Lexington, Neb., is secretary of the company, which has a capital stock of $200,000.

SEGUIN, TEX.—T. Johnson of this city is president of the Grande Valley Canal & Irrigation Co., recently organized with a capital stock of $1,000,000. Mr. Johnson is reported as stating that a complete system of irrigating canals will be established in the lowest border counties of Webb, Encinal, Starr, Hidalgo and Cameron, and several hundred thousand acres of arid land brought under cultivation. The water will be obtained from the Rio Grande.

ELLENSBURG, WASH.—The contract for constructing the Middle Kittitas canal has been awarded to Peter Costello, Spokane, at $136,747, according to press reports.

RIVERSIDE, CAL.—Jas. T. Taylor of this city has been engaged by the San Francisco Savings Union Bank, represented by C. H. Phillips, San Luis Obispo, to re-subdivide lots in the El Cajon Valley, known as the Santee tract, and to examine the property to investigate the feasibility of developing water for irrigating purposes.

WINCHESTER, CAL.—Bids are asked until Aug. 7 for the purchase of $130,250 in bonds of the San Jacinto and Pleasant Valley irrigation districts. P. Milliken, Secy.

NEW COMPANIES.—Paxton & Hershey Irrigating Canal & Land Co., Omaha, Neb.; $100,000; W. A. Paxton, Sr., W. A. Paxton, Jr., F. T. Ranson, A. S. Briggs and John H. Hershey.——Equitable Irrigation & Water Power Co., Grant, Neb.; $25,000; J. W. Leeny, J. H. Spelts, W. H. Saunders, E. H. Hill, T. W. Hull, Geo. Cockel and others.——Cahaenga Gold Mining & Irrigation Co., Los Angeles, Cal.; $100,000.

SEWERS.

LANCASTER, N. H.—F. L. Fuller has prepared plans for a system, estimated to cost $47,800.

MIDDLEBURY, VT.—A meeting was held July 23 to consider the question of constructing the proposed system.

AMHERST, MASS.—O. D. Hunt, Town Clerk, writes us that 6,000 ft. of 4-in. pipe sewers will be constructed under the direction of the selectmen, and that none but town labor will be employed.

ATHOL, MASS.—Bids are asked until July 31 for constructing 73,000 ft. of 18 to 8-in. pipe sewers, as stated in our advertising columns. E. V. Wilson, Chn. Com.

CAMBRIDGE, MASS.—Bids are asked until Aug. 1 for constructing an inverted siphon in the line of Commercial Ave. sewer at East Cambridge. L. M. Hastings, Cy. Engr.

MEDFORD, MASS.—The council has voted to issue $40,000 in bonds for constructing sewers.

PROVIDENCE, R. I.—Bids are asked until July 30 for the construction of about 7,000 ft. of 15 to 8-in. pipe sewers, and 432 ft. of 22-in. brick sewer; brick, pipe, cement, etc., to be furnished by the city. Robt. E. Smith, Comr. Dept. Pub. Wks.

AVON, N. Y.—S. D. Backus, Canandaigua, writes us that he has prepared plans for about five miles of 8 to 6-in. pipe sewers at this place; average cut 6 ft.; estimated cost, $11,000. The plans are now being considered by the state board of health.

BINGHAMTON, N. Y.—The council has adopted ordinances for constructing sewers in several streets.

CAZENOVIA, N. Y.—J. A. Loyster, Cy. Clk., writes us that the plans for the proposed system have not yet been voted upon by the citizens.

ELMIRA, N. Y.—The following were the lowest bidders for constructing sewers: Thomas Murray, sewers in three streets; Henry Koop, two streets; and Timothy Connors, one street.

FULTON, N. Y.—The board of trustees are discussing plans for a system, which is estimated to cost between $15,000 and $20,000.

MEDINA, N. Y.—The residents of Main St. have petitioned for an 18-in. sewer in that street.

ROCHESTER, N. Y.—The council has adopted an ordinance for constructing a sewer in University Ave., estimated to cost $13,000.

SYRACUSE, N. Y.—The city engineer has submitted estimates for constructing 45 to 18-in. sewers in several streets, estimated to cost $8,944.

PLAINFIELD, N. J.—The ordinance providing for the construction of a system of sewers was passed July 25 and signed by the mayor. Bids will be advertised for Aug. 7 in the local papers and in Engineering News of that week for the construction of about five miles of the work this fall, and the contracts are expected to be let about Aug. 15 so that construction can be commenced before Sept. 1. Recent examinations of the soil supposed to be most saturated with water revealed the fact that at 6 ft. below the surface there was absolutely no water, and this is supposed to be the only place where water would be found. The indications are that the entire excavation will be of easy character. The system as planned for immediate construction contemplates about 15 miles, together with the preparation of sewage disposal beds. J. W. McMurray is city clerk.

SMYRNA, DEL.—Bids are asked until Aug. 1 for the construction of 15,000 ft. of pipe sewers, including manholes, etc.; separate bids will also be received for furnishing the pipe. Wm. A. Faries, Secy.

ALLEGHENY, PA.—The council has adopted ordinances for constructing 30 to 15-in. pipe sewers, estimated to cost about $12,500, and 42 to 36-in. brick sewers, estimated to cost $2,350. Robt. Dilworth, Cy. Clk.

ALTOONA, PA.—The committee has readvertised for bids for constructing sewers in 18th St.——The committee is discussing a project for sewers in Walnut and Willow Aves.

PITTSBURG, PA.—Bids are asked until July 28 for constructing 24 to 15-in. pipe sewers in 25 streets, and until Aug. 1 for constructing 20 to 15-in. pipe sewers in three streets. E. M. Bigelow, Dir. Pub. Wks.

READING, PA.—Jacob Mayer has been awarded a contract for constructing a pipe sewer in Church St. at $5,312.

TAMPA, FLA.—The citizens have voted to issue bonds for a system, according to reports.

AVONDALE, O.—Bids are asked until Aug. 17 for constructing 1,559 ft. of pipe sewers. W. E. Wynne, Corporation Clk.

BUCYRUS, O.—We are informed that the city will construct an intercepting sewer along the Sandusky River, which stream has been a menace to the public health for several years during the dry season. H. L. Weber is city engineer.

CLEVELAND, O.—The board of control has completed plans for sewers in 15 streets. James Hossack, Secy.

IRONTON, O.—Bids are asked until Aug. 16 for constructing 14,296 ft. of 20 to 8-in. pipe and 1,330 ft. of 34 × 24-in. brick sewers. J. R. C. Brown, Cy. Engr.

WAPAKONETA, O.—Bids are asked until Aug. 2 for furnishing a supply of drain tile. Samuel Craig, Engr.

LANSING, MICH.—H. D. Bartholomew, Cy. Engr., has estimated the cost of constructing a 6 × 4 ft. brick sewer in Weinman's Creek, at about $12,000.

LE MARS, IA.—The council has received the following bids for constructing 20,814 ft. of 22 to 8-in. pipe sewers:

Hurley & Co., Des Moines	$10,911
Mohler Supply Co., Sioux City	10,737
Dubuque Construction, Co., Dubuque	10,998
Murray Bros., Cedar Rapids	11,618
*Smith & Conlin, Sioux City	10,524
D. McDonald, Des Moines	12,435
Wickhom Bros., Council Bluffs	11,298
Mohan & Coffee, Le Mars	12,031
M. R. Land, Des Moines	13,319
Danforth & Peterson, West Bay City, Mich	11,646
F. Stinson, Council Bluffs	12,682
Charles Savonell, Sioux City	11,768
E. J. Hanlon, Sioux City	11,591
Anderson & Lindquist, St. Paul	10,540

*Awarded contract.

MAQUOKETA, IA.—The council is discussing the question of issuing bonds for $12,500 for a system.

DULUTH, MINN.—The council is considering plans for constructing sewers in a portion of West Duluth.

MINNEAPOLIS, MINN.—It is proposed to construct at once the Oswald sewer in First Ave., estimated to cost $43,000.

ST. JAMES, MINN.—Bids are asked until July 31 for constructing 3,240 ft. of 12-in. pipe sewers. Engr., C. F. Loweth, 94 E. Fourth St., St. Paul. S. M. Serkland, Village Clk.

TEXARKANA, TEX.—The city wishes to grant a franchise for a system of sewers, water-works, etc., as stated in our advertising columns. John Stewart, Cy. Secy.

SEATTLE, WASH.—The city engineer has completed plans for improving the system in the lower part of the city at an estimated cost of $13,500.

BERKELEY, CAL.—The town engineer is preparing plans for seven miles of sewers, estimated to cost $40,000.

POMONA, CAL.—Phil. Stein writes us that the board of trade is discussing the question of sewers in the hopes that the citizens will petition the council to take steps to issue bonds for a system.

STREETS.

BROOKLYN, N. Y.—Bids are asked until Aug. 3 for flagging portions of sidewalks in 12 streets. A. T. White, Comr. Cy. Wks.

NEW YORK, N. Y.—Bids are asked by the commissioner of street improvements of Wards 23 and 24, 2622 Third Ave., until Aug. 2 for grading and laying crosswalks in two streets.——Bids are asked by the department of parks until Aug. 1 for furnishing 1,000 gross tons asphalt mastic, 100 gross tons refined bitumen or paving cement, 800 gross tons Long Island gravel or grit, 300 cords hickory or oak wood, and 4,000 cu. yds. of screened gravel for work in Central Park.

ROCHESTER, N. Y.—The council has adopted ordinances for paving sidewalks in Genesee St. with cement, estimated cost $9,900, and Exchange St. with Medina blocks, estimated cost, $10,500.

SCHENECTADY, N. Y.—The council has voted to pave two streets with asphalt.

BRADFORD, PA.—An election will be held July 31 to vote on increasing the debt $83,336 for improvements.

PITTSBURG, PA.—Bids are asked until July 28 for grading and paving 15 streets. E. M. Bigelow, Dir. Pub. Wks.

BALTIMORE, MD.—Bids are asked until July 30 for furnishing 22,500 cu. yds. of sand for repaving three streets. A. E. Smyrk, Cy. Comr.——Bids are asked until Aug. 2 for paving at Lexington Market. J. T. Oster, Inspector of Bldg.

JACKSONVILLE, FLA.—The council has passed ordinances for paving Market St. with brick and also for paving other streets with different materials. W. C. West, Recdr.

NEW ORLEANS, LA.—Bids are asked for filling the square bounded by Prytania, Perrier, Valmont and Leontine Sts., up to the city grade; also for curbing on two sides of said square. H. H. Hall 173 Common St.

LOUISVILLE, KY.—Bids are asked by the board of public works until July 31 for paving portions of 20 streets with brick or artificial stone.

CINCINNATI, O.—Bids are asked by the board of administration until Aug. 13 for macadamizing and improving two streets, and until Aug. 14 for paving one street with brick.

DAYTON, O.—Bids are asked until Aug. 2 for grad-

ing and paving eight streets. C. A. Herbig, Cy. Comptroller.

IRONTON, O.—Bids are asked until Aug. 15 for grading and paving 13,310 lin. ft. with brick, asphalt or asphalt blocks. Cy. Engr., J. R. C. Brown; G. H. Davies, Cy. Clk.

FRANKLIN, IND.—It is reported that the city engineer and a committee are examining the brick paving in other cities with a view to paving streets in this city with brick.

HAUGHVILLE, IND.—The clerk has been ordered to readvertise for bids for paving the sidewalks of Highland Ave. with brick, cement or gravel.

INDIANAPOLIS, IND.—The board of public works has adopted resolutions for paving three streets with brick and one with asphalt.

SEYMOUR, IND.—It is reported that the question of paving the streets with brick is being discussed.

DETROIT, MICH.—The committee has recommended that 20 streets be paved at an estimated cost of about $190,000, and eight streets be repaved at an estimated cost of about $175,000.

LANSING, MICH.—The contract for paving Capitol Ave. with Hayden blocks has been awarded to Woodcock & Kneal, at about $8,585.

SAGINAW, MICH.—Street and sewer improvement bonds for $150,000 have been sold to Rollins & Co., Boston, Mass., at a premium of $4,605.

BELLEVILLE, ILL.—Bids are asked until Aug. 4 for paving with brick, as stated in our advertising columns. F. W. Puderer, Cy. Clk.

CHICAGO, ILL.—Bids are asked until July 31 for improving 17 streets and alleys. H. J. Jones, Comr. Pub. Wks.

MILWAUKEE, WIS.—The City Improvement Co. has been incorporated with a capital stock of $36,000, by Otto Frils, W. S. Buckley and W. H. Thhlin.

HOUSTON, TEX.— Bids are asked until Aug. 13 for constructing sidewalks in 15 streets. J. T. Browne, Mayor.

SEATTLE, WASH.—The board of public works is discussing proposed paving, estimated to cost $56,325.

HALIFAX, N. S.—The council has voted in favor of paving Lower Water St. next year, estimated to cost $70,000 to $80,000.

HAMILTON, ONT.—The lowest bid for paving 50,834 sq. yds. with Trinidad Lake asphalt was that of Kramer-Irwin Co., Toronto, at $145,425, according to reports.

ELECTRIC LIGHT AND POWER.

BROCKWAYVILLE, PA.—The power house and plant of the Brock mines was destroyed by fire July 15; loss, $7,000. It is probable that the power house will be rebuilt at once.

MONTROSE, PA.—The borough has voted to put in an electric light plant.

NORWOOD, PA.—Bids are asked until Aug. 1 for electric lighting. G. C. Skelton, Secy.

GEORGETOWN, D. C.—An effort is being made by the Georgetown & Tenleytown R. R. Co. to get permission to supply electricity for light and other purposes along the route.

CARDINGTON, O.—Bids are asked for a complete electric light plant, for which plans have been prepared. G. W. Bowyer, Cy. Clk.

COLLINWOOD, O.—Bids are asked until Aug. 1 for lighting the streets for one or more years. L. A. Wilson, Village Clk.

YOUNGSTOWN, O.—Bids are asked until Aug. 11 for 300 or more 2,000-c. p. arc lights for one to ten years. H. W. Calvin, Clk.

GREEN LAKE, WIS.—It is reported probable that an electric plant will be put in, at an estimated cost of $5,000.

IOWA FALLS, IA.—The council is discussing the granting of a franchise for an electric light plant.

ANAHEIM, CAL.—The council has passed an ordinance for the construction of an electric light plant.

SALT LAKE CITY, UTAH.—The committee has received the following bids for an electric light plant for the county building:

American Electric Co.	$11,952
Inter Mountain Electric Co.	9,750
R. M. Jones.	11,520
Utah & Montana Machinery Co.	16,108
L. C. Trent & Co.	10,975

NEW COMPANIES.—Lockport Gas & Electric Light Co., Lockport, N. Y.; $150,000; Benjamin Blanchard, Boston; H. B. Wilson and Emerson McMillan, New York; A. H. Ivans, S. C. Lewis, E. M. Ashley, Lockport.——National Automatic Lighting Co., Bay City, Mich; $100,000; manufacturing automatic hydrocarbon lighting devices.——Montgomery Electric Light & Power Co., Montgomery, Ill.; $10,000; Lysander Hord, Jr., J. G. Habermeyer, W. C. Weise.——New Athens Electric Light & Power Co., New Athens, Ill.; $4,500; Isfried Probst, Paul Lehman.——Los Angeles Edison Electric Co., Los Angeles, Cal.; $500,000; Thomas Addison, Alameda; S. E. Kearney, J. E. Green, J. P. Martin, San Francisco.——New York & Dobbs Ferry Light, Heat & Power Co., Dobbs Ferry, N. Y.; $150,000.——Elizabethtown Electric Light Co., Elizabethtown, Pa.; $10,000; Treas., A. C. Oler; J .G. Stauffer, D. Z. Witmer.——Cleveland Storage Battery Co., Cleveland, O.; $150,000; manufacturing electrical devices, such as storage batteries, cars, engines, motors, etc.; H. C. Bunts, W. H. Beavis, C. A. Cook, G. S. Kain, J. H. Fuller.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

DAM.—Dover, N. H.—The Cocheco Mfg. Co. will shut down its mills Aug. 1 for a few weeks to construct a new dam and make other improvements.

DITCH WORK.—Wapakoneta, O.—Bids are asked until Aug. 1 for the construction of the Pusheta Creek ditch, in 34 sections. Samuel Craig, Engr.

Frankfort, Ind.—Bids will be received next month, according to reports, for constructing the Young ditch, in Perry township, about five miles in length.

GAS HOLDER—White Plains, N. Y.—The White Plains Gas & Electric Co. is reported as about to spend $15,000 for a large gas holder and other improvements.

STEEL PIPE.—Milwaukee, Wis.—Bids are asked until July 28 for furnishing 12,000 ft. of 2½-in. steel pipe for use of fire department. G. H. Benzenberg, Cy. Engr.

DREDGING—Washington, D. C.—Bids are asked until Aug. 8 for dredging at Port Royal, S. C. E. O. Matthews, Ch. of Bureau of Yards and Docks, Navy Dept.

STATION—Syracuse, N. Y.—Jas. Stewart & Co., St. Louis, have been awarded a contract for building a $300,000 passenger station for the New York Central at this place.

SHAFTING, ETC.—Chicago, Ill.—Bids are asked until July 28 for furnishing shafting, bearings, clutch pulleys, etc., for power station. Wm. K. Ackerman, Cy. Comptroller.

ELECTRIC WIRING.—Brooklyn, N. Y.—Bids are asked until July 31 for additional work and electric wiring at the 13th Regiment armory. Arch., R. L. Dans, Garfield Bldg. D. B. Phillips, Secy.

FIREPROOF BUILDING.—Fairfax, Va.—Bids are asked until Aug. 24 for the construction of a fireproof county building, including plans and specifications, as stated in our advertising columns. F. W. Richardson, Clk.

TELEGRAPH MATERIAL—Washington, D. C.—Bids are asked until Aug. 13 for furnishing 50 miles No. 9 G. I. wire, 50 miles No. 14 G. I. wire, 500 iron telegraph poles, 2,000 insulation plugs, 3,000 insulators and 1,000 insulator brackets. A. W. Greeley, Ch. Signal Officer, War Dept.

TILING, ETC.—New York, N. Y.—Bids are asked by the department of public parks until Aug. 1 for drainage pipes, etc., for the slate tanks for the aquarium; tiling the floor of the aquarium, and for hard rubber piping, fixtures, valves, etc., for the aquarium in Castle Garden Bldg., in Battery Park.

IRON AND STEEL WORK—Milwaukee, Wis.—The contract for the stone and iron columns in 1st, 2d, 3d and 4th stories, and the construction steel and iron work of 2d, 3d, 4th and 5th or attic floors, including steel bearing plates for ends of beams, channels, etc., in the U. S. public building in this city has been awarded to W. Bayley & Sons, Milwaukee, at $32,660.

IRON CYLINDERS, ETC.—New York, N. Y.—Bids are asked for furnishing 5,760 ft. of 10-ft. iron cylinders; also for cement broken stone, etc., for the foundation for the proposed Atalantis, to be built in the Atlantic Ocean 13 miles from the Long Island shore, as stated in our advertising columns. This project was described in our issue of June 28. C. M. Coen, 3 Union Square.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
July 27.	Sewer,	Cincinnati, O.	July 12
July 27.	Water-works system,	Northfield, Minn.	July 12
	Advertised, Eng. News, July 12.		
July 27.	Fire alarm syst'm,	New Brunswick, N.J.	July 19
July 28.	Power-house and bldg.,	Detroit, Mich.	June 28
	Advertised, Eng. News, June 28 to July 12.		
July 28.	Sewers,	Washington, D. C.	July 19
	Advertised, Eng. News, July 19 and 26.		
July 28.	Bridge,	Savannah, Ga.	July 19
July 28.	Pipe sewers,	Pittsburg, Pa.	July 26
July 28.	Paving (15 streets),	Pittsburg, Pa.	July 26
July 28.	Shafting, etc.,	Chicago, Ill.	July 26
July 28.	Steel pipe,	Milwaukee, Wis.	July 26
July 30.	Street improvement bonds,	Ashland, O.	July 5
July 30.	Street improvement bonds,	Norwood, O.	July 5
July 30.	Highway,	Toledo, O.	July 5
July 30.	Asphalt pav'g (29,700 sq.yds.),	Dayton, O.	July 12
July 30.	Water-works bonds,	Marshall, Minn.	July 12
July 30.	Bridges,	Philadelphia, Pa.	July 19
July 30.	Sewer bonds ($126,000),	Laconia, N. H.	July 19
July 30.	Sewers,	Philadelphia, Pa.	July 19
July 30.	Bridge (77-ft.),	Slatington, Pa.	July 19
July 30.	Levee work,	Delta, La.	July 19
July 30.	Bridge (160-ft.),	Hamilton, O.	July 19
July 30.	Water-wks. ext'ns,	Glens Falls, N. Y.	July 26
July 30.	Sand (22,500 cu. yds.),	Baltimore, Md.	July 26
July 30.	W.-wks system,	Blue Earth City, Minn.	July 26
July 30.	Sewers (7,000 ft.),	Providence, R. I.	July 26
July 31.	Bridge,	New Westminster, B. C.	June 21
July 31.	Rock removal,	Newport, R. I.	July 12
	Advertised, Eng. News, July 5 to 26.		
July 31.	Sewer,	Cincinnati, O.	July 12
July 31.	Street improvements,	Avondale, O.	July 12
July 31.	Plumbing, etc.,	Washington, D. C.	July 12
	Advertised, Eng. News, July 12 and 19.		
July 31.	Cement,	New York, N. Y.	July 19
July 31.	Dredging,	New York, N. Y.	July 19
July 31.	Artesian well,	Marshall, Minn.	July 19
July 31.	Water-works system,	Marshall, Minn.	July 19
July 31.	Electric light plant,	Marshall, Minn.	July 19
July 31.	Pipe sewers (73,000 ft.),	Athol, Mass.	July 26
	Advertised, Eng. News, July 26.		
July 31.	Stone arch bridge,	Brockton, Mass.	July 26
July 31.	Water bonds ($35,000),	Coxsackie, N. Y.	July 26
July 31.	Macadamizing,	Stapleton, N. Y.	July 26
	Advertised, Eng. News, July 26.		
July 31.	Brick paving, etc.,	Louisville, Ky.	July 26
July 31.	Cast iron pipe,	Chicago, Ill.	July 26
July 31.	Improving 17 streets,	Chicago, Ill.	July 26
July 31.	Pipe sewers (3,240 ft.),	St. James, Minn.	July 26
July 31.	Electric wiring,	Brooklyn, N. Y.	July 26
Aug. 1.	Sewer bonds ($100,000),	Victoria, B. C.	June 28
Aug. 1.	Water-works system,	Carey, O.	July 5
	Advertised, Eng. News, July 5 and 12.		
Aug. 1.	Bonds,	Ironton, O.	July 19
Aug. 1.	Water-works system,	Morris, Ill.	July 19
	Advertised, Eng. News, July 19 and 26.		
Aug. 1.	Dam, etc.,	Montreal, Que.	July 19
Aug. 1.	Asphalt, cement, etc.,	New York, N. Y.	July 26
Aug. 1.	Electric lighting,	Norwood, Pa.	July 26
Aug. 1.	Pipe sewers,	Pittsburg, Pa.	July 26
Aug. 1.	Electric lighting,	Collinwood, O.	July 26
Aug. 1.	Ditchwork,	Wapakoneta, O.	July 26
Aug. 1.	Water-works system,	Coggon, Ia.	July 26
Aug. 1.	Water-works system,	Walker, Ia.	July 26
Aug. 1.	Tiling, etc.,	New York, N. Y.	July 26
Aug. 1.	Sewer siphon,	Cambridge, Mass.	July 26
Aug. 1.	Tiling, etc.,	New York, N. Y.	July 26
Aug. 1.	Grading (B. M., T. & N. B. Ry),	Hazleton, Pa.	July 26
	Advertised, Eng. News, July 26.		
Aug. 1.	Pipe and sewers (15,000ft.),	Smyrna, Del.	July 26
Aug. 2.	Dredging steamer,	Wilmington, N. C.	July 12
Aug. 2.	Water-works system,	Manitus, N. Y.	July 19
Aug. 2.	Drainage work,	Sumas, B. C.	July 19
Aug. 2.	Crosswalks,	New York, N. Y.	July 26
Aug. 2.	Paving,	Baltimore, Md.	July 26
Aug. 2.	Paving,	Dayton, O.	July 26
Aug. 2.	Drain tile,	Wapakoneta, O.	July 26
Aug. 2.	Water-works system,	East Dubuque, Ill.	July 26
Aug. 3.	Bridge,	Red Wing, Minn.	July 12
	Advertised, Eng. News, June 21 and 28.		
Aug. 3.	Flagging,	Brooklyn, N. Y.	July 26
Aug. 4.	Street improvements,	Mansfield, O.	July 12
Aug. 4.	Brick paving,	Belleville, Ill.	July 26
	Advertised, Eng. News, July 26.		
Aug. 5.	Water bonds ($500,000),	Portland, Ore.	July 26
Aug. 6.	Electric lighting,	Rome, N. Y.	June 14
Aug. 6.	Bridge (50-ft.),	Vicksburg, Miss.	July 19
Aug. 6.	Levee work,	Donaldsonville, La.	July 19
Aug. 6.	Street improvements,	Marion, O.	July 19
Aug. 6.	Macadamizing,	Toledo, O.	July 19
Aug. 6.	Bridges,	Leavenworth, Kan.	July 19
Aug. 6.	Water-works and bonds,	Harvard, Neb.	July 19
Aug. 6.	Asphalt or brick paving,	Houston, Tex.	July 19
Aug. 6.	Bridge,	Austin, Tex.	July 26
Aug. 7.	Cast iron pipe,	Hoboken, N. J.	July 19
Aug. 7.	Granite paving,	Cincinnati, O.	July 19
Aug. 7.	Arch,	Cohoes, N. Y.	July 26
Aug. 7.	Water pipe, etc.,	St. Louis, Mo.	July 26
Aug. 7.	Irrigation bonds,	Winchester, Cal.	July 26
Aug. 8.	Bridge,	Cleveland, O.	July 12
Aug. 8.	Dredging,	Washington, D. C.	July 26
Aug. 9.	Buildings,	Columbus, O.	July 19
Aug. 9.	Brick paving (12,635 sq. yds.),	Lima, O.	July 19
Aug. 9.	Stone curbing (13 Sts.),	Danville, Ill.	July 19
Aug. 9.	Water-works system,	Fullerton, Neb.	July 26
Aug. 9.	Water bonds ($12,500),	Fullerton, Neb.	July 26
Aug. 10.	Bridges,	Cincinnati, O.	July 26
	Advertised, Eng. News, July 19 to Aug. 2.		
Aug. 10.	Water-works extensions,	Syracuse, N. Y.	July 26
	Advertised, Eng. News, July 26.		
Aug. 11.	Sewers,	Sandusky, O.	July 19
Aug. 11.	Trenching,	Olean, N. Y.	July 26
Aug. 11.	Electric lighting,	Youngstown, O.	July 26
Aug. 13.	W.-wks. and bonds,	Humphrey, Neb.	July 19
Aug. 13.	Telegraph material,	Washington, D. C.	July 26
Aug. 13.	Macadamizing,	Cincinnati, O.	July 26
Aug. 13.	Sidewalks (15 streets),	Houston, Tex.	July 26
Aug. 14.	Brick paving,	Cincinnati, O.	July 26
Aug. 15.	Architectural competition,	Atlanta, Ga.	July 12
Aug. 15.	Water-works bonds,	Hillsboro, O.	July 19
Aug. 15.	Sewer bonds ($10,000),	Riverside, O.	July 19
Aug. 15.	Electric l't plant,	Summerside, P. E. I.	July 19
Aug. 15.	Paving (15,310 lin. ft.),	Ironton, O.	July 26
Aug. 15.	Pumping stations,	Brooklyn, N. Y.	July 26
	Advertised, Eng. News, July 26.		
Aug. 16.	Water-works bonds,	Glendale, O.	July 19
Aug. 16.	Brick sewers (1,330 ft.),	Ironton, O.	July 26
Aug. 16.	Pipe sewers (14,296 ft.),	Ironton, O.	July 26
Aug. 17.	Pipe sewers (1,559 ft.),	Avondale, O.	July 26
Aug. 22.	Drainage canal,	Chicago, Ill.	June 28
	Advertised, Eng. News, June 28 to Aug. 14.		
Aug. 22.	Pmpg eng. house, etc.,	New York, N.Y.	July 26
Aug. 24.	Fireproof building,	Fairfax, Va.	July 26
	Advertised, Eng. News, July 26 to Aug. 16.		
Sept. 1.	Pipe, pump, etc.,	Honolulu, H. I.	July 19
	Advertised Eng. News, July 19 to Aug. 2.		
Sept. 1.	Electric lighting,	Portland, Ore.	June 21
Sept. 3.	Bridge,	Dillon, Mont.	July 5
No date.	Iron cylinders,	New York, N. Y.	July 26
	Advertised, Eng. News, July 26.		
"	" Franchises,	Texarkana, Tex.	July 26
	Advertised, Eng. News, July 26.		
"	" Filling,	New Orleans, La.	July 26
"	" Electric light plant,	Cardington, O.	July 26
"	" Water-works system,	Rankin, Pa.	July 26
"	" Gas compressors,	Findlay, O.	July 19

CONTRACT PRICES.

PIPE.—Albany, N. Y.—Geo. I. Bailey, Supt., writes us that the following bids were received July 17 for 1,600 gross tons of 30-in. water pipe and 45,000 lbs. of special castings; contracts not yet awarded:

	Specials, per lb.	Pipe, per ton.
Camden Iron Wks.	2½ cts.	$20.70
Chattanooga Foundry & Pipe Wks.	2⅛ "	21.67
F. B. Hawkins & Co.	2 "	22.25

WELL.—Northfield, Minn.—M. W. Skinner, Chn. Com., writes us that the contract for sinking an artesian well for the proposed water-works has been awarded to J. F. McCarthy, Minneapolis, at $1.58 per ft. for 100 ft. or less of 8-in. well; casing, 88 cts. per ft.

PUMPING ENGINE.—Abington, Mass.—A. H. Wright, Supt., writes us that the following bids have been received for a 2,500,000-gallon high-duty pumping engine, duty to be not less than 90,000,000; prices are exclusive of foundations:

Holly Mfg. Co.		$13,000
Deane Steam Pump Co.,	triple expansion	9,475
" "	vertical	11,872
Henry R. Worthington,	triple expansion	12,500
Edward P. Allis Co.,	compound	7,000
"	horiz. eng., vert. pump	8,200
"	vertical	12,000
"	"	13,500
Geo. F. Blake Mfg. Co.,	triple expansion	10,750
" "	cross-compound	14,000
" "	vertical	19,000
Barr Pumping Engine Co.,	cross-compound	8,385

STAND-PIPE.—Zanesville, O.—Press reports state that Schreiber & Co., Cincinnati, were the lowest bidders for the superstructure of the proposed new steel stand-pipe, at $4,840 for one 25 × 80 ft., or $7,373 for one 25 × 100 ft.

STAND-PIPE, PIPE AND HYDRANTS.—Kirkwood, Ill.—Chas. F. Sturtevant, Engr., St. Louis, writes us that contracts have been awarded as follows: For a 10 × 100-ft. steel stand-pipe, erected on foundation furnished by city, J. Matthews, Harvey, Ill., at $2,060; 10 to 4-in. pipe, Addyston Pipe & Steel Co., Addyston, Ohio, at $17.35 per ton, f. o. b., Kirkwood; Empire hydrants, Ripley-Detrick Supply Co., at $19.90 each. The other bids for pipe ranged from $18.80 to $20.45, and a bid of $19.40 each for National hydrants was received.

STONE PAVING.—Brooklyn, N. Y.—The following bids have been received for paving with granite blocks:

	Paving, per sq. yd.	New curb, per lin. ft.	Bridging, per sq. ft.	Bluestone, Grading, complete.
Charles Hart	$2.15	$.65	$.40	$950
Thomas Gilbride	2.00	.65	.40	1,200
Thomas McCann	2.00	.75	.50	900
A. E. Donovan	2.10	.60	.40	750
T. C. Mayher	1.99	.75	.40	750
Norton & Gorman	2.00	.60	.38	643

ASPHALT PAVING—Utica, N. Y.—The following bids were received July 13 for paving three streets with asphalt, the bidders being: 1, Utica Paving Co. (Bermudez asphalt); 2. Warren-Scharf Asphalt Paving Co.; 3. Trinidad Refining Co.:

	1.	2.	3.
Tile drains, per lin. ft.	$0.35	$0.40	$0.15
Resetting curb, per lin. ft.	.08	.10	.10
New curb and setting, per lin. ft.	.52	.50	.30
Catch basins, each	33.00	28.00	25.00
Branch pipe, straight, per lin. ft.	.40	.50	.50
Branch pipe, curves, etc., per lin. ft.	.75	.75	.75
Manholes, each	40.00	40.00	30.00
Paving, per sq. yd.	[1]2.20	[2]2.75	[2]2.43
Repaving, cobble, per sq. yd.	.30	.35	.25
Relaying crosswalks, per sq. ft.	.06	.08	.06
New sandstone crosswalks, per sq. ft	.20	.22	.22
Concrete, extra, for foundation, per cu. yd	5.00	5.00	5.00
Moving catch basins, each	8.00	8.00	8.00
Credit for old cobble, per sq. yd.	.06	.20	.45
Credit for old crosswalks, per sq. yd.	.10	.05	.15

[1]$1.92 for Howard Ave. and Chatham St.
[2]$2.35 " " "
[3]$1.72 " " "

The total bids were as follows:

	Utica Paving Co.	Warren-Scharf Co.	Trinidad Co.
Park Ave.	$26,995.25	$31,025.75	$22,009.75
Howard Ave.	15,734.60	18,473.50	12,761.50
Chatham St.	6,041.40	7,081.75	4,332.85

BRICK PAVING.—Bucyrus, O.—Harry L. Weber, Cy. Engr., writes us that the following bids were received July 17 for about 9,000 sq. yds. of brick paving in Spring St.: A. J. Yawger, $1.84 per sq. yd. for Bucyrus pavers or $1.77 for Canton standard, Trimble or Middleport pavers; A. H. Gardner, $1.76; Frayer & Kell, $1.71 for Bucyrus pavers, or $1.64 for Canton standard or Trimble pavers.

SEWER BRICK.—Minneapolis, Minn.—The following bids have been received for furnishing the city 2,500,000 sewer brick: John S. Bower, 500,000 brick at $7.50 per M.; Kelly Brick & Tile Co., 2,500,000, at $7.25; John A. Berg, 250,000 at $6.97, and 250,000 at $6.50; C. J. Swanson, 500,000 at $7; P. Ruydell, 1,000,000 at $6.73; Wisconsin Red Pressed Brick Co., 500,000 at $6.95, and 500,000 at $7; Twin City Lime & Cement Co., 200,000 at $7.10; Northern Hydraulic Pressed Brick Co., 500,000 at $6.50, 500,000 at $6.75 and 500,000 at $6.99.

GRANITE BLOCKS.—Baltimore, Md.—Contracts for furnishing granite paving blocks have been awarded at $49 to $51.50 per M.

ASPHALT.—New York, N. Y.—The bids for furnishing asphalt for resurfacing the walks in Central Park have been rejected, as stated last week, the prices being reported as follows:

Henry G. Horner, Brooklyn, per ton	$15.45
Sicilian Asphalt Co., New York	16.85
T. Hugh Boorman, New York	16.75

SEWERS.—Faribault, Minn.—C. F. Loweth, Engr., St. Paul, writes us that 16 bids were received for the proposed sewers and the contract awarded to O'Neil & Smith, Faribault, at $7,266, at the following prices: 8-in. pipe sewer, 53 cts. per lin. ft.; 10-in., 73 cts.; 15-in., 96 cts.; manholes, $50 each; lampholes, $8; house connection chimneys, $2; flush tanks, $55; Red Wing sewer pipe will be used.

DITCH WORK.—Marion, Ind.—Ancil E. Ratliff, Surveyor Grant County, writes us that contracts for constructing the Galatia Creek ditch have been awarded to Hawkins & Brinker, Marion, at 12 cts. per cu. yd. for the Heaveline branch: Morris Brookshire, Fairmount, 15 cts. per cu. yd. for the tile drain; Geo. W. Ice, Fairmount, 10 cts. per cu. yd. for the open part above the lake; work to be completed by Jan. 1.

METAL MARKET PRICES.

LEAD.—New York: 3.45 to 3.55 cts. Chicago: 3.15 to 3.2 cts. St. Louis: 3.15 to 3.22 cts.

NAILS.—Pittsburg: $1.15 for wire, and 95 cts. to $1 for cut at mill, in carload lots.

FOUNDRY AND PIG IRON.—New York: $10.50 to $13. Pittsburg: $10.75 to $12. Chicago: $9.50 to $11.

TRACK MATERIAL.—New York: angle bars, 1.25 to 1.4 cts.; spikes, 1.5 to 1.7 cts.; track bolts, 2 to 2.1 cts. with square and 2.1 to 2.3 cts. with hexagon nuts. Chicago: angle bars, 1.25 to 1.35 cts.; spikes, 1.7 to 1.8 cts.; track bolts, 2.1 to 2.15 cts., with hexagon nuts.

RAILS.—New York: $24 to $25 at eastern mills and at tide water; old rails, $11.00 for iron, and $10.00 for steel; steel rails fit for relaying, $16.00 to $16.50; light rails, $22 to $24; girder rails, $21 to $24. Pittsburg: $24 for standard sections. Chicago: $25 to $27; old rails, $10.50 for iron and $6.50 to $9.00 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.4 to 1.5 cts.; channels, 1.4 to 1.5 cts.; angles, 1.3 to 1.35 cts.; tees, 1.5 to 1.6 cts.; universal mill plates, 1.25 to 1.35 cts.; steel plates, 1.35 to 1.4 cts. for tank, 1.45 to 1.5 cts. for shell, 1.6 to 1.65 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.25 to 1.3 cts.; channels, 1.25 to 1.3 cts.; angles, 1.2 to 1.35 cts.; tees, 1.35 to 1.4 cts.; universal mill plates, 1.2 to 1.35 cts.; steel plates, 1.25 to 1.3 cts. for tank, 1.4 cts. for shell, 1.45 cts. for flange, 2½ to 3 cts. for ordinary firebox, and 3.35 to 3.4 cts. for locomotive firebox. Chicago: beams, 1.5 cts.; channels, 1.5 cts.; angles, 1.45 cts.; tees, 1.65 cts.; universal plates, 1.45 cts.; steel plates, 1.45 to 1.55 cts. for tank, 1.5 to 1.6 cts. for shell, 1.65 to 2.1 cts. for flange, 1.65 to 5 cts. for firebox.

IRON AND STEEL.—The "Journal of Commerce" reports that neither foundry nor mill grades of American pig iron are being sold here, except in a very ordinary way. In remote instances contracts are worked that involve deliveries running during the balance of the year, but the purchases are chiefly for thirty to sixty days' supply. Prices show no positive change, but are still rather weak. Orders for rails and track supplies come this way very slowly, and railway patronage is without sign of improvement. Prices are not quoted lower, but continue rather weak for the lines that are free from manufacturers' combinations. Heavy structural material continues rather low in price, and business is moderate. Ordinary merchant iron and steel remain rather dull, with prices leaning more or less in buyers' favor.

INDUSTRIAL NOTES.

THE ELLIOTT CAR WORKS, of Gadsden, Ala., will start up their foundry shortly on some large orders for car wheels for electric railways.

THE FOX SOLID PRESSED STEEL CO., of Joliet, Ill., has an order for 4,000 pressed steel car trucks, to be used on coal cars for the Delaware, Lackawanna & Western R. R.

THE NEW ENGLAND CAR COUPLER CO., of Portland, Me., has been organized to manufacture the National car coupler, invented by J.A. Hinson. Capital stock, $100,000; J. W. Fellows and Josiah G. Dearborn, of Manchester, N. H.; Fred Hoode, of Boston, Mass.; and J. A. Hinson, of Chicago.

THE PENNSYLVANIA R. R. will, it is said, build this year at its shops at Altoona 100 locomotives. This is quite a reduction as compared with the previous years, when the number was from 230 to 240. While the number of locomotives to be constructed is less than at other times, owing to the financial stringency, the standing of the rolling equipment is to be maintained and a large number of cars will be built to keep up the usual freight equipment.

THE YOUNGSTOWN BRIDGE CO., of Youngstown, O., has been awarded the contract for the Pope's Crossing Bridge on the Washington & Chesapeake Beach Ry.; and the Black River bridge at Vicksburg, Miss., consisting of 150 ft. draw span and two fixed spans of 50 and 100 ft. each., together with a viaduct approach. It has also the contract for the steel and iron work for the buildings of the Northwestern Iron & Steel Co.'s rolling mills at Tacoma, Wash.

NEW COMPANIES.—Ransome Subway Co., Chicago, Ill.; $1,000,000; Wm. G. Arnold, K. B. Knudson and C. W. Townsend.——Crouch Construction Co., Rapid City, So. Dak.; $50,000; Chas. D. Crouch and Ernest Schlenming.——Marion Hedge & Wire Fence Co., Marion, O.; $60,000; Pres., Fred Haberman; Secy., H. R. Young; Man., L. T. Goodnow.——Wisconsin & New Duluth Bridge Co., Superior, Wis.; $100,000; Geo. B. Hudnall and J. M. McCabe.——United Drilling Co., Pittsburg, Pa.; $25,000, with $500 paid in; drilling wells; A. C. Dravo, Guy E. Campbell and J. T. Patterson.——Biddle Railway Car Electric Lighting Co.; New York, N. Y.; $500,000, with $1,000 paid in; W. Biddle and C. A. Williams, of Brooklyn, N. Y.; C. E. Poucher, New York.——Eagle Lake Brick & Tile Works, Eagle Lake, Ill.; $8,000; Fred Erickson, Arthur Struve and Fred Brands.——Warren Brick Co., Rush City, Minn.; $60,000; A. J. Stowe, C. F. Jackson and T. W. Wadlow.——Moran City Gas, Fuel & Prospecting Co., Moran, Kan.; $20,000; B. D. Lee, J. S. Miller and H. Varner.——Ottawa Gas & Heating Co., Ottawa, Kan.; $25,000; W. H. Clark, P. P. Elder and W. C. Allen.

MUNICIPAL BOND MARKET.

New York, July 24, 1894.

The most prominent feature of the general market within the last few days has been an anxious renewal of inquiries for first-class investment securities. The demand which had been so eager in the earlier months of the year fell off to almost nothing with the development of the labor disturbances of May, June and the earlier part of July, so that it was thought that very little of the money distributed in the semi-annual interest and dividend payments would seek reinvestment. The situation, except for the uncertainty attending the tariff bill's fate, has, however, been very much cleared, and the trend of the municipal bond market for the past few weeks shows that a very large part of this month's heavy disbursements is seeking revenue producing bonds or stocks.

True the municipal bond market has been only moderately active, but so much interest is again being manifested in its doings that prices, especially for the most desirable class of securities, are easily maintained. The great dullness marking the market the last few weeks was attributed altogether to the recent labor troubles, which naturally created a feeling of uneasiness on the part of investors. But, with the elimination from the situation of the disturbing features, the outlook has improved to such an extent that the competition among brokers to pick up bargains is keener than ever. It is almost impossible to buy any of the prime issues. W. H. Newbold's Son & Co., of Philadelphia, and Harvey Fisk & Sons, of New York, report that they have sold nearly all of the $3,600,000 3½% city of Philadelphia loan awarded to them, and this without making any public offering of the loan at all. In the same way any broker having a round lot of first-class bonds becomes an object of special attention among the bond dealers and there is the sharpest kind of manoeuvring among them to secure the price even at constantly advancing quotations.

Some Chicago critics were disposed to regard the failure of the effort to dispose of $3,000,000 4% drainage bonds as an indication of how the strike conditions have demoralized the municipal bond market. That this is absurd and that the Chicago bond sale fiasco was merely due to the unwillingness of investors to buy the securities of a town whose authorities are open sympathizers with lawlessness is demonstrated by the active bidding that is made for the bond issues of even small cities. Thus Holyoke, Mass., had ten bidders for its $140,000 4% bond sale, and for the $150,000 Saginaw, Mich., 5% bonds there were sixteen bidders. The large cities, too, find no difficulty in making sales.

Thus, Brooklyn, N. Y., had any number of bidders for the $750,000 4% bonds spoken of in these columns last week, but no award was made, as the question has been raised as to whether the statutory limit of indebtedness will not be exceeded, should the bond issue in question be made. If the $3,000,000 tax warrant certificates issued some few years ago are included in the total, then the statutory limit is exceeded some $19,000. It was decided by the courts once before that these certificates do not properly constitute a part of the municipality's debt, but Mayor Schieren and Comptroller Corwin think it best to be on the safe side, and will make no definite awards till the Corporation Counsel has decided on the matter.

Some recent bond sales of importance have been $50,000 Kings County armory 4s at 103, $100,000 Kings County Savings Institution 4s at 104, and $200,000 more at prices ranging from 103 to 103.53. Yonkers sold last night $57,000 school 4s to Street, Wykes & Co., at 108, the highest of seven bids. This is an exceptionally good price. Some current bond quotations are herewith appended as indicating to interested parties credits commanded by various municipalities:

MUNICIPAL BONDS.

	Price.
City of Pueblo, Col., Gen. Fund 6s	113
County of Flathead, Mont., 20-year, Gold 6s	107⅞
City of Bartow, Fla., 20 year 6s	102
Williamsbridge, N. Y., Highway 6s	136¼
City of Bethany, Mo., Gold 6s	105½
Knightstown, Ind., 6s	111½
County of Park, Mont., Gold 6s	109¼
County of Fergus, Mont., Gold 6s	106
City of New Whatcom, Wash., Gold 6s	105¾
School District of Brainerd, Minn., 6s	108½
City of Meridian, Miss., 6s	107½
County of Bexar, Tex., Gold 6s	103½
City of Omaha, Neb., 5s	111
City of Jefferson, Ia., 5s	102½
City of Hastings, Neb., 5s	102
City of Salt Lake, Utah, Gen. Fund 5s	103¼
City of Tacoma, Wash., 20-year 5s	101
City of Dayton, O., School 5s	107½
County of Portage, Wis., Refunding 5s	107¾
City of Findlay, O., School 5s	105
City of Sheldon, Ia., School 5s	101½
City of Brooklyn, N. Y., Pub. Market 4s	110½
City of Elmira, N. Y., 4s	105¾
City of Niagara Falls, N. Y., Sewer 4s	105½
City of Auburn, N. Y., 4s	108⅞
City of Cleveland, O., 4s	104⅝
City of Manchester, N. H., 4s	106½
Town of Methuen, Mass., 4s	107
City of Waterbury, Conn., 4s	105½
City of Chicago, Ill., Gold 4s	104¼

RAILWAY STOCK MARKET.

New York, July 24, 1894.

Trading in stocks has fallen to the ordinary midsummer level. The situation has so far cleared that, were there any activity to the stock market, an advance in quotations would seem to be the proper thing in the ordinary course of events. It is likely that the only change in prices possible for many stocks is an advance. This is conceded by most people, yet there is considerable apprehension in many quarters as to the ultimate fate of two important groups of the railway stock market, the trunk lines and the grangers. The continued depression in the prices of wheat and other cereals, added to the great prostration of business throughout the West, makes the continuation of dividend payments by such few Western roads as still distribute anything among stockholders a matter of great uncertainty and even improbability. In the East the trunk line managers have about reached the limit of saving in operating expenses, and, unless a sudden revival in business, particularly manufacturing, follows the settlement of the tariff legislation, decrease in gross receipts will also about represent the fallings off in net earnings.

The so-called "hospital stocks," Union Pacific, Northern Pacific, etc., are for the moment depressed by reason of the disclosures made in the Atchison expert examination, when it was discovered that annual gross earnings as reported are really about $7,000,000 out of the way, that amount having been refunded to shippers as a rebate and being charged up to special accounts, thus accounting for the tremendous floating debt. It is admitted that all its competitors have indulged in the same pernicious practice, being forced thereto by the sharp competition and hiding it to evade the provisions of the Inter-State Commerce law. Most of the other roads indulging in the practice, however, deduct the rebate from the gross receipts before making any statement of earnings and so avoid publishing any misleading figures.

Outside of these classes of stocks, the market as a whole stands up well, and, no matter what happens, is not likely to deceive much further. The feeling of the speculative community is much more cheerful than it has been for some time, and, while sentiment does not bring about advances, it is likely to induce outside buyers to enter the stock market and these are what create decided upward movement. The outlook at present warrants the purchase of railroad stocks.

RAILWAY STOCK MARKET.

Railway stocks.	Closing prices July 24
Alton & Terre Haute	33
Atchison, Topeka & Santa Fe	3⅝
Baltimore & Ohio	71½
Canada Southern	49
Chesapeake & Ohio	16½
Chicago, Burlington & Quincy	75
Chicago & Northwestern	104½
Chicago, Milwaukee & St. Paul	58⅝
Chicago, Rock Island & Pacific	66½
Cleveland, Cincinnati, Chicago & St. Louis	35
Delaware, Lackawanna & Western	162½
Delaware & Hudson	130½
Lake Shore & Michigan Southern	129½
Louisville & Nashville	45½
Missouri Pacific	24¾
Missouri, Kansas & Texas	12½
Mobile & Ohio	18
New Jersey Central	100½
New York Central	97⅛
New York & New England	6
New York, New Haven & Hartford	175
New York, Chicago & St. Louis, 1st pfd.	62
New York, Lake Erie & Western	13⅝
New York, Ontario & Western	14¾
New York, Susquehanna & Western	14¼
Northern Pacific	3½
Northern Pacific, pfd.	13⅞
Philadelphia & Reading	17½
Richmond Terminal	14⅞
St. Paul & Omaha	36
Southern Pacific	18
Texas Pacific	8½
Union Pacific	8⅞
Wabash pfd.	13¼
Wheeling & Lake Erie	10

BOSTON RAILWAY STOCKS.

	July 24
Boston & Albany	205
Boston & Maine	147
Fitchburg	69
Old Colony	179

PHILADELPHIA RAILWAY STOCKS.

	July 24
Lehigh Valley	37½
Pennsylvania Railroad	49⅝